UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PREVENTION, PESTICIDES, AND TOXIC SUBSTANCES
WASHINGTON, D.C. 20460

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MEMORANDUM

SUBJECT: **Etridiazole**: Revised Occupational and Residential Exposure (ORE) Assessment for the Reregistration Eligibility Decision (RED) document. PC Code 084701, DP Barcode D266474

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PHED: Yes, Version 1.1

This document has been revised and updated to reflect refinements in the risk assessment assumptions for the potential human health effects associated with non-dietary exposure to etridiazole. Refinements were made in order to express maximum feasible mitigation of occupational handler exposure, and to correct minor errors identified in the May 25 meeting with registrants. This revised document is intended to support the development of the etridiazole Reregistration Eligibility Decision document (RED).

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EXECUTIVE SUMMARY FOR ETRIDIAZOLE

Summary Description for Etridiazole:

Etridiazole, the active ingredient in Terrazole® and other products, is a soil fungicide used to control damping off and root and stem rots caused by species of *Pythium* and *Phytophthora*. Etridiazole is also combined with other pesticides and fungicides in currently labeled products. The primarily agricultural use (about half of all etridiazole sold) is on cotton at the time of seed planting. The second-highest use (over one-third of total product) of etridiazole is application to various ornamental plants and shrubs by horticultural nurseries and for interiorscapes. Etridiazole is used on golf course fairways, tees, and greens. It is also registered for use as a seed treatment on barley, beans/peas, peanuts, corn, safflower, sorghum, soybeans and wheat; of these crops, peanuts have received a modest amount of treatments with etridiazole. There are currently no homeowner uses for etridiazole, however, golfers may be exposed to treated turf. Handler, post-application occupational and post-application non-occupational exposure scenarios are addressed in this ORE assessment.

Handler Risk Assessment:

No chemical-specific handler exposure data were submitted in support of the reregistration of etridiazole. Therefore, most of the mixer, loader, or applicator scenarios were evaluated for short- and intermediate term exposures and cancer risk using the Pesticide Handlers Exposure Database (PHED), Version 1.1. No PHED data exist for exposure during seed treatment, and there is little data in the literature. There is no data for powered blower application of granular product. Therefore, the Agency requested and received permission from Uniroyal to use a commercial seed treatment worker exposure study, which was submitted for reregistration of another chemical. In addition, a published occupational exposure study was used to assess on-farm seed treatment exposures. Numerous mixer/loader, applicator, and mixer/loader/applicator scenarios were evaluated.

Typical worker clothing is represented by the scenarios with a single layer of work clothes and chemical-resistant gloves. A margin of exposure (MOE) of 100 or greater for short- and intermediate-term occupational exposure does not exceed HED=s level of concern. About one-quarter of the short- term (14 of 53) and 40% of intermediate-term (20 of 53) scenarios had MOEs that exceed HEDs level of concern (i.e., MOE < 100). An additional layer of clothing and respiratory protection had very little effect, effectively raising only one additional short-term MOE and two intermediate-term scenarios above the minimum MOE of 100.

Nearly all scenarios for which engineering controls were feasible had MOEs of 100 or greater when controls were added. The one exception is mixing and applying wettable powder to turf via groundboom at the highest application rate, for an intermediate-term exposure, which had a MOE of 71. The engineering control that was applicable to most scenarios was a water soluble bag (WSB) for the wettable powder. Currently, the WSB is not available for etridiazole. Also, seven

short-term and nine intermediate-term exposure scenarios that are common in nursery and turf work, had MOEs less than 100 and there were no feasible engineering controls. An enclosed system for handling and loading granular products would be desirable to reduce handler exposure, but is also not available at this time. The hand-held application methods have no known engineering controls, but some may be replaced by use of chemigation. As these values are based on chemical surrogate data with lower vapor pressures, the effect of adding respiratory protection would probably be greater than indicated, but the baseline inhalation exposure would also be greater. Double-layer clothing, or coveralls over work clothes, and respirators also add the risk of heat stress and decrease range of motion, visibility, and communication. Therefore engineering controls are preferred to additional personal protective equipment (PPE). There were no data for granular application by powered dust blower.

Worker cancer risks were estimated for private and commercial handlers using *typical* application rates. Baseline (no glove, single layer of clothing) cancer risks exceeded 10^{-4} in one-third (10 of 34) of private and one-half of commercial (15 of 34) applicators. Cancer risks exceeded 1.0×10^{-4} for one-quarter (9 of 34) of "private" or non-commercial applicator exposure scenarios, where workers wore a single layer of clothing and chemical-resistant gloves. For commercial applicators wearing the same protective equipment, one third (12 of 34) had cancer risks greater than 1.0×10^{-4}. By using additional PPE and/or engineering controls, about two-thirds of the handler scenarios cancer risks were reduced below 1.0×10^{-4}, except for those application methods which had no known method of engineering control (six scenarios) or no data (3 scenarios). Again, most of these were the scenarios involving application of granular products to turf and soil, discussed above.

Occupational Post-Application Risk Assessment

The registrant submitted studies of residues on turf, transfer of residues, and a post-application study of greenhouse workers using treated potting soil. The turf residue transfer study was found to be adequate for assessment of golf course workers.

None of the MOEs for post-application worker scenarios exceeded the Agency's levels of concern. Greenhouse or nursery workers are expected to be exposed to the post-application residues of potting soil on a regular basis (potentially more than six months per year), for an estimated 4 hours per day. The MOE required for long-term exposure is 300. The 12-hour re-entry dose for potting soil handling from the submitted study was used to estimate an MOE of 900 for intermediate or long-term exposures (wearing a single layer of clothing but no gloves), and a cancer risk of 2.9×10^{-5}. Different levels of contact with treated turf were estimated, using tractor mowing to represent the lower, and hand mowing the higher range of exposure. These exposure MOEs ranged from 650 to 1300. The lifetime cancer risk for mowing is estimated at 2.0×10^{-5} to 4.0×10^{-5}, based on the turf residue data. Risks for handling pre-treated seed while planting cotton were estimated using PHED surrogate data. Short-term MOEs were between 48,000 and 60,000 and intermediate-term MOEs between 18,000 and 22,000. Estimated cancer risks for private farmers handling and planting treated cotton seed were between 6.8×10^{-8} and

8.4×10^{-8}. Commercial planters handling treated cotton seed (20 days per year) have an estimated cancer risk of 2.0×10^{-7} to 2.4×10^{-7}, depending on the amount of pesticide applied.

Non-Occupational Risk Assessment

There are no labeled homeowner uses of etridiazole. However, as etridiazole can be applied to golf courses up to several times a year, there is a potential for short-term non-occupational exposure to adults and children entering treated golf courses. However, a risk assessment for this exposure scenario for the general population, including infants and children, was not conducted since a short-term dermal toxicological endpoint of concern was not identified for the general population. A risk assessment was conducted for female golfers of child-bearing age (13-50 years old) using the developmental NOAEL of 15 mg/kg/day. Because the FQPA Safety Factor Committee determined that the 3x FQPA safety factor does not apply to the acute dietary risk assessment, it is also not applicable to the short-term dermal risk assessment as both assessments are based on the same toxicity study. Therefore, an MOE of 100 or greater is adequate for female golfers 13-50 years old. The dermal exposure estimate for female golfers was based on a turf transferable residue study as opposed to using default residential SOP assumptions. For female golfers (13+ years old), the short-term non-occupational MOE of 17,000 does not exceed the Agency's level of concern.

Cancer risk estimates were determined for all adult golfers. The exposure estimate was derived from the turf transferable residue study data and assumed a four hour exposure occurring 18 times a year. The estimated cancer risk for adult golfers is 8.9×10^{-7} .

Incident Reports:

Relatively few incidents of illness have been reported due to etridiazole. However, at least two incidents were reported in California citing specific health effects from contact with recently treated soil. In 1997 an incident involving a greenhouse worker experiencing symptoms after potting soil, and on another occasion, a worker handled soil that was treated with etridiazole and experienced eye and skin illness for two years. Detailed descriptions of 10 cases submitted to the California Pesticide Illness Surveillance Program (1982-1995) were reviewed and in one case, etridiazole was judged to be responsible for the health effects. A total of 30 unintentional exposures were reported to the Toxic Exposure Surveillance System from 1993 through 1996. All thirty cases involved adults and older children ages six to nineteen, nine of which had a minor outcome, two with moderate outcome, and none that were considered life-threatening. These incidents indicate that etridiazole is of concern for post-application worker exposures.

ORE Concerns:

The Scotts labels for ornamental use do not clearly state that the product is not for residential use. There is a data gap for all seed handling activities, and the studies used for this assessment were considered limited, not compliant with study guidelines, not chemical-specific, and should be interpreted together with default scenarios for range-finding purposes. There are virtually no applicable data (beyond the studies cited) on the use of dust formulations in occupational settings.

Therefore data is required for both commercial and on-farm settings. Caution should be used in interpreting both the pesticide handler and seed handler scenarios which used default data, given the high vapor pressure of etridiazole, and inhalation exposure may be underestimated. Product labeling should be upgraded to comply with 42 CFR Part 84 and 29 CFR 134, particularly to require the use of organic vapor filtering respirators during mixing and loading, due to the high vapor pressure (1.1×10^{-2} mm Hg) of etridiazole. Current labeling requires a dust/mist filtering respirator for mixing and loading products containing higher concentrations (ie. greater than 10%) of active ingredient.

OCCUPATIONAL/RESIDENTIAL EXPOSURE AND RISK ASSESSMENT

1.1 Purpose

This document is intended to support the development of the etridiazole Reregistration Eligibility Decision document (RED) and includes the results for HED's review of the potential human health effects associated with non-dietary exposure to etridiazole.

1.2 Criteria for Conducting Exposure Assessments

An occupational and/or residential exposure assessment is required for an active ingredient if: (1) certain toxicological criteria are triggered **and** (2) there is potential exposure to handlers (i.e., mixers, loaders, applicators, etc.) during use or to persons entering treated sites after application is completed.

Short-, intermediate-, and long-term occupational exposures to etridiazole are anticipated, while non-occupational exposures are anticipated to be only short-term after application. These assumptions are based upon the labels,[1] information supplied by the registrant,[2] and usage reviews by the Biological and Economic Assessment Division (BEAD).[3]

1.3 Summary of Toxicity Concerns Relating to Occupational and Residential Exposures

The toxicological database on etridiazole is considered incomplete, and endpoints of concern, other than oral, are not route-specific. Although etridiazole has low acute toxicity, it does cause skin and eye irritation. Etridiazole produces tumors in rats and is considered a probable human carcinogen.[4]

1.3.1 Acute Toxicity Categories

Etridiazole has low acute oral, dermal, and inhalation toxicity and produces moderate irritation to the eyes (Toxicity Categories III and IV). It is a moderate skin sensitizer.

1.3.2 Toxicology Endpoints Used in the Risk Assessment

Short-term Dose and Endpoint For Risk Assessment (Dermal and Inhalation): A developmental NOAEL of 15 mg/kg/day based on reduced fetal body weights, decreased viability and increased skeletal malformations/variations observed at the LOAEL of 45 mg/kg/day.

Intermediate- and Long-term Dose and Endpoint for Risk Assessment(Dermal and Inhalation): A NOAEL of 4.8 mg/kg/day based on increased absolute and relative liver weights, renal tubule cell karyomegaly, hepatocytomegaly and spongiosis hepatis in male rats observed at the LOAEL of 30.43 mg/kg/day.

Except for an acute inhalation toxicity study, no inhalation studies are available. An acceptable dermal absorption study was not available. Since an oral NOAEL was selected, a dermal absorption factor of 100% (default value) and an inhalation absorption factor of 100% (default value) should be used during route to route extrapolation. In addition, the acidic pH of Terrazole technical (3-4 in water) would cause considerable skin irritation and would most likely breach the skin barrier.

Because the dermal and inhalation equivalent oral doses are based on the same endpoint for the same exposure periods, they should be added together and compared to the NOAEL to determine the margin of exposure (MOE).

Carcinogenicity: Etridiazole is classified as a Group B2 carcinogen (Probable Human Carcinogen) based on the occurrence of multiple tumor types in male and female rats. The Q_1^* = 0.0333 $(mg/kg)^{-1}$. [5]

Margins of Exposure for Occupational/Residential Exposure Risk Assessment

The HIARC determined that the risk assessment for short-, intermediate-, and long-term dermal and inhalation exposures are required. For occupational exposure, a MOE of 100 is adequate for short- and intermediate-term dermal and inhalation risk assessments, and a MOE of 300 is required for long-term dermal and inhalation exposure risk assessments due to the data gap for a chronic toxicity study in dogs. For non-occupational exposure risk assessments, a MOE of 100 is adequate for females 13-50. Because a short-term dermal toxicological endpoint of concern was not identified for the general population, and the FQPA Safety Factor Committee determined that the 3x FQPA safety factor does not apply to the acute dietary risk assessment, it is also not applicable to the short-term dermal risk assessment as both assessments are based on the same toxicity study. Therefore, a post-application re-entry risk assessment was not performed for the general population or for children on treated golf course turf.

1.4 Incident Data

The following is a summary of the incident data reviewed by J. Blondell of HED.[6]

A pesticide incident occurred in 1997 (Incident #5351-1), when a woman experienced dizziness, shortness of breath, and malaise. She was participating in a study involving four workers who hand potted soil for nearly three days at a greenhouse. All applications were made at the appropriate intervals but one post treatment was done at four hours instead of twelve hours required by the label. No further information on the disposition of the case was reported.

Poison Control Center Data - 1993 through 1996

A total of 30 unintentional exposures were reported to the Toxic Exposure Surveillance System from 1993 through 1996. All thirty cases involved adults and older children ages six to nineteen,

nine of which had a minor outcome, two with moderate outcome, and none that were considered life-threatening. Eight cases were seen in a health care facility, none were hospitalized, and none were admitted for critical care. There were too few cases with outcome determined to do a meaningful comparison on the number of symptomatic cases. The percent of cases seen in a health care facility was only slightly above the average for all pesticides. These comparisons are shown in the table below.

Comparison between etridiazole and all pesticides for percent cases with symptomatic outcome (SYM), moderate or more severe outcome (MOD), life-threatening or fatal outcome (LIFE-TH), seen in a health care facility (HCF), hospitalized (HOSP), or seen in an intensive care unit (ICU) for adults and children six years and older reported to Poison Control Centers, 1993-1996.

Pesticide	SYM*	MOD*	LIFE-TH*	HCF*	HOSP*	ICU*
Etridiazole	85%	15%	0 %	27 %	0 %	0 %
ALL PESTICIDES	72%	12%	0.37%	21%	7.6%	3.3%

* Symptomatic cases based on those cases with a minor, moderate, major, or fatal medical outcome. Denominator for SYM, MOD, and LIFE-TH is the total cases where medical outcome was determined. Denominator for HCF is all exposures. Denominator for HOSP and ICU is all cases seen in a health care facility.

California Data - 1982 through 1995

Detailed descriptions of 10 cases submitted to the California Pesticide Illness Surveillance Program (1982-1995) were reviewed. In one case, etridiazole was judged to be responsible for the health effects. In the one case, a worker handled moist soil that was treated with etridiazole and experienced eye and skin illness for two years. The case did not require hospitalization or was not known to take time off work due to the exposure.

On the list of the top 200 chemicals for which the National Pesticide Telecommunications Network (NPTN) received calls from 1984-1991 inclusively, etridiazole was not reported to be involved in human incidents. Relatively few incidents of illness have been reported due to etridiazole.

1.5 Summary of Use Patterns and Formulations

1.5.1 Occupational Use Products

According to the EPA OPP REFS label tracking system, there are 27 active labels, including 1 technical concentrate, 3 wettable powders (WP), 8 granular, 8 emulsifiable concentrate (EC), 4 flowable concentrates (FC), and 3 dust formulations. Note that products made by Scotts are not restricted-use labeled, yet may contain up to 40% etridiazole. Also note that etridiazole is combined in some active labels with other fungicides and pesticides, some of which are also carcinogens, in the same product. At the present, no policy exists for addressing multiple active

ingredients, but the Agency recognizes that additional acute or chronic health risks may be added in these cases. Some of the other active ingredients, e.g. captan, disulfoton, thiophanate-methyl, and aldicarb, are being evaluated by the Agency at this time for handler and post-application health risk.

All of the labels require a minimum of a single layer of protective clothing, either long-sleeved shirt and long pants or coveralls, chemical-resistant gloves, and shoes with socks for handlers. The seed treatment dust label requires a double layer of clothing. All but two of the labels require a minimum of a dust/mist respirator for mixer/loaders or other handlers. The labels for neither the granular product nor the liquid seed treatment require use of a respirator. The Worker Protection Standard designated reentry interval (REI) for post-application workers is currently set at 12 hours after application for all products. Workers entering prior to 12 hours must wear WPS-specified clothing and may only perform limited functions.

Residential Use: There are currently no homeowner uses for etridiazole.

ACTIVE PRODUCT REGISTRATIONS

Registration Number	% Active Ingredient	Formulation	Product Name
000264-00319	2.5	G	TEMIK TSX GRANULAR PESTICIDE
000400-00405	5.8	EC	TERRACLOR SUPER X EMULSIFIABLE
000400-00406	2.5	G	TERRACLOR SUPER X GRANULAR
000400-00408	1.63	G	TERRACLOR SUPER-X SOIL FUNGICIDE W/ DI-SYSTON
000400-00413	98.6	T	TERRAZOLE TECHNICAL
000400-00416	35	WP	TERRAZOLE 35% WETTABLE POWDER
000400-00417	25	EC	TERRAZOLE 25% EMULSIFIABLE
000400-00419	5	G	TERRAZOLE 5% GRANULAR FUNGICIDE
000400-00422	44	EC	TERRAZOLE 4EC
000400-00423	40.7	F	TERRAZOLE 4 FLOWABLE FUNGICIDE
000400-00455	5.8	F	TERRACLOR SUPER X FLOWABLE
000400-00456	3.8	G	TERRACLOR SUPER X 18.8G
000400-00475	4.3	EC	TERRACLOR SUPER X PLUS DI-SYSTON EC
007501-00054	5.0	D	GUSTAFSON TERRACLOR SUPER X 20-5 DUST WITH GRAPHITE
007501-00057	5.8	EC	GUSTAFSON TERRA-COAT L-205N
007501-00111	2.5	D	GUSTAFSON 4-WAY SEED PROTECTANT
007501-00153	2.5	D	4-WAY PEANUT SEED PROTECTANT FUNGICIDE
034704-00679	5.8	EC	PCNB + LIQUID SEED TREATER
058185-00005	30	EC	KOBAN 30
058185-00007	30	WP	TRUBAN FUNGICIDE 30% WETTABLE POWDER
058185-00008	25	EC	TRUBAN FUNGICIDE 25% EMULSIFIABLE CONCENTRATE
058185-00010	15	WP	BANROT BROAD SPECTRUM FUNGICIDE 40% WETTABLE POWDER
058185-00013	5	G	TRUBAN FUNGICIDE

058185-00016	1.3	G	KOBAN 1.3 G
058185-00019	40.7	F	KOBAN FLOWABLE [40%]
058185-00020	40.7	F	TRUBAN FLOWABLE [40%]
058185-00023	3	G	BANROT 8-G FUNGICIDE

1.5.2 Type of Pesticide and Targeted Pests

Etridiazole [5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole] is a soil fungicide used to control damping off and root and stem rots caused by species of *Pythium* and *Phytophthora*. The specific mechanism of action is not known, but is believed that the thiazoles, of which etridiazole is a member, break down in the soil to either isothiocyanate or a dithiocarbamate. It is a reddish-brown liquid which is formulated as wettable powders, emulsifiable concentrates, dusts, and granules.

1.5.3 Registered Use Sites and Use Patterns

As etridiazole is used only as a soil-incorporated fungicide and seed treatment, there are a limited number of use patterns. It is used for at-planting in-furrow crop soil treatments (only cotton at this time); as a soil treatment, either by drenching or addition to potting soil, for ornamentals and interiorscapes; on ornamental turf and golf course fairways, greens, and tees, either by spray or broadcast application; and as a seed treatment, applied in either large commercial facilities, or at the farm. Total annual use of etridiazole is estimated by BEAD at approximately 75,000 lb ai (these estimates are approximate and therefore totals by crop may not exactly concur with overall total cited). An estimated 42,500 lbs ai of etridiazole is applied to cotton at planting, with a typical application rate of about 0.17 lbs ai/acre. About 28,000 lbs ai of etridiazole are believed to be applied by nurseries; mainly to control for root diseases (USDA, NAPIAP Report, 1-CA-96). About 5,000 lbs ai of etridiazole are also applied annually to golf courses. All of the dusts are formulated by one company, Gustafson, for seed treatment. Only a limited amount of seed treatment (less than 1% of the market per BEAD) is done in this country using this active ingredient, but all active labels are evaluated for handler and post-application health risks. Etridiazole is registered for use as a seed treatment on barley, beans/peas, peanuts, corn, safflower, sorghum, soybeans and wheat; of these crops, peanuts have received a modest amount of treatments with etridiazole.

At this time, products containing etridiazole are intended for occupational uses only. No homeowner uses are referenced on any etridiazole labels reviewed. The Scotts labels for turf application do not proscribe use by private individuals, but the company representative stated these products were sold to PCOs only, and sales materials are targeted at landscape and turf professionals. The 10 percent (%) granular golfcourse turf product should contain the statement "for professional use only."(memo from J.Evans to J. Mitchell, 11/16/94 re: Graybeard Waivers, wherein EPA granted waiver for golf course use only, on condition of *specific* labeling prohibiting application to home lawns, sod farms, or municipal parks).[7] A non-occupational risk assessment is required for the exposure of the public to treated turf on golf courses. Exposure of the public

to etridiazole residues on golf course turf is anticipated to occur infrequently.

1.5.4 Application Rates

Application rates are based on the registered label, but also take into account the physical nature of the use site, the physical nature of the formulation (e.g., form and packaging), the equipment required to deliver the chemical to the use site, the application rate required to achieve an efficacious dose, along with seasonal limit to applications.

In-furrow crop treatment rates (soil-incorporated) for etridiazole range from 0.13 to 0.38 lbs. ai per acre. Soil is also treated for ornamental plants for nurseries and greenhouses. The typical rate for soil drench treatment is 6 ozs. ai/1000 sq. ft. (0.375 lb/1000 sq. ft. or 16.3 lb/acre), with a range of 1.5 oz. ai/1000 sq. ft. (0.093 lb) to 17.5 oz ai/1000 sq. ft. (1.09 lb ai/1000 sq. ft. or 47.6 lb ai/acre). Etridiazole can also be added dry to potting soil, typically at 1.1 oz ai/cubic yard. Application to turf on golf courses is in the range of 0.7 to 2.8 oz ai/1000 sq. ft. (1.9 lb ai/acre to 7.6 lb ai/acre). Seed treatment rates range from 0.0078 lb ai/100 lbs seed to 0.0625 lb ai/100 lb seed.

1.5.5 Methods and Types of Equipment for Mixing, Loading, and Application

Wettable powder and emulsifiable concentrates of etridiazole require mixing with water to the label-specified dilution. This is usually performed by scooping or pouring the formulation into a mixing tank, often of 100 gallons or more in capacity, with mechanical agitation to keep the resulting emulsion homogenized and prevent variations in application strength. Smaller amounts may be handled when applying these formulations either in a low-pressure hand wand, or via a tiller-planter (or seed drill)-mounted system, where smaller total quantities are applied. Large commercial operations, such as seed treatment, may have mechanical, automated, metered pumps which require only connecting the formulation to the pump. Small seed treatment operations, such as seed box (or “hopper box”) mixing, and soil mixing may be done by measuring small amounts by hand (wearing label-required gloves) into the mixing device. Granular and dust formulations are scooped or poured (without mixing) directly into the application device.

Etridiazole emulsions and granules may be applied to seed in-furrow using planters with spray attachments. As noted above, seed may also be treated in the planter box before planting. Emulsions may be applied to soil or turf using boom sprayers or smaller sprayers attached to tractors, all-terrain vehicles (ATVs), or mowers. Granular formulations may be applied to soil or turf using broadcast or cyclone spreaders trailered behind one of these vehicles. Portable, strap-on spreaders (“belly grinders”) and push-type (cyclone) spreaders may also be used in turf maintenance, particularly for spot treatments. Hand dispersal or power dust blowers are occasionally used for application to trenches or small areas. Soil drenching may be done by automated irrigation systems (chemigation), and/or by low- or high-pressure hand-held spray wand. The label does not list hand sprinkling (i.e., watering can) and this use in commercial application is considered unlikely.

OCCUPATIONAL EXPOSURES AND RISKS

2.1 Handler Exposures and Risks

2.1.1 Handler Exposure Scenarios

HED has determined that short- (up to seven days) and intermediate-term (up to 180 days) exposure to pesticide handlers is likely during the occupational use of etridiazole in agricultural, greenhouse, nursery, and golf course environments. The anticipated use patterns and current labeling indicate 24 major occupational exposure scenarios based on the types of equipment and techniques that can potentially by use to make etridiazole applications. These 24 different scenarios, which are presented as a total of 53 methods to account for variable application rates, serve as the basis for the quantitative exposure risk assessment developed for occupational handlers. These scenarios include:

(1a) mixing and loading of wettable powder formulation for golf course ground boom application;
(1b) mixing and loading of wettable powder formulation for chemigation application;
(2) loading granular formulation for in-furrow soil application;
(3a) mixing and loading liquid (EC/FC) formulation for in-furrow soil application;
(3b) on-farm seed treatment using liquid formulation;
(3c) loading/application of liquid (EC) formulation for seed treatment (commercial, Uniroyal Vitavax study data);
(3d) seed handling during liquid seed treatment (commercial, Uniroyal Vitavax study data);
(4) loading dust [using wettable powder as surrogate] formulation for seed treatment (commercial);
(5a) spraying golf course turf with groundboom equipment;
(5b) applying liquid in-furrow [groundboom surrogate];
(6) loading and applying granular formulation in-furrow (broadcast surrogate);
(7) mixing, loading, and applying liquid (EC/FC) in-furrow [groundboom surrogate];
(8a) treating seed manually using dust formulation on farm (study data);
(8b) treating seed manually using liquid (EC) formulation on farm;
(9) mixing, loading, and applying liquid (EC) formulation as drench using low-pressure hand wand;
(10) mixing and applying liquid (EC) as soil drench using high pressure hand wand;
(11) loading and applying granular formulation to golf course turf with “belly grinder”;
(12) loading and applying granular formulation to golf course turf with push-type cyclone spreader;
(13) loading and applying granular formulation to turf using tractor-drawn broadcast spreader;
(14) mixing, loading, and applying wettable powder formulation to golf course turf with ground boom;
(15) loading and mixing granular formulation with soil;
(16) mixing and applying wettable powder formulation to potting soil;

(17, 18) loading and applying granular formulation to soil using a belly grinder;
(19, 20) loading and applying granular formulations to soil using push-type cyclone spreader;
(21, 22) loading and applying granular formulation to soil by a spreader drawn by a tractor;
(23) loading and applying granules with a power duster (no data); and
(24) applying granules by hand to soil trench or turf.

All scenarios use PHED surrogate exposure data unless otherwise noted.

2.1.2 Handler Exposure Scenarios -Assumptions

Handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure. Daily dermal and inhalation exposures, dose levels, and risks to handlers were calculated as described below. The first step is to calculate daily dermal and inhalation exposure using the following:

$$\text{Daily Dermal Exposure}\left(\frac{\text{mg ai}}{\text{day}}\right) = \text{Unit Exposure}\left(\frac{\text{mg ai}}{\text{lb ai}}\right) * \text{Rate}\left(\frac{\text{lb ai}}{\text{Acre}}\right) * \text{Daily Treated}\left(\frac{\text{Acres}}{\text{day}}\right)$$

Where:

Daily Dermal Exposure = Amount deposited on the surface of the skin that is available for dermal absorption, also referred to as potential dose (mg ai/day);
Unit Exposure = Normalized exposure value derived from August, 1998 PHED Surrogate Exposure Table, no chemical-specific handler data were available for this assessment (mg ai/pound ai applied);
Use Rate = Normalized application rate based on a logical unit treatment such as acres, a practical maximum value is generally used (lb ai/A) for each scenario; and
Daily Acres Treated = Normalized application area based on a logical unit treatment such as acres (A/day).

Daily inhalation exposures were calculated using the following:

$$\text{Daily Inhalation Exposure}\left(\frac{\text{mg ai}}{\text{day}}\right) = \text{Unit Exposure}\left(\frac{\text{ug ai}}{\text{lb ai}}\right) * \frac{\text{1 mg}}{\text{1000 ug}} * \text{Rate}\left(\frac{\text{lb ai}}{\text{acre}}\right) * \text{Daily Treated}\left(\frac{\text{Acres}}{\text{day}}\right)$$

Where:

Daily Inhalation Exposure = amount that is available for absorption, also referred to as potential dose (mg ai/day);
Unit Exposure = Normalized exposure value derived from August, 1998 PHED Surrogate Exposure Table, no chemical-specific handler data were available for this assessment (mg ai/pound ai applied);
Use Rate = Normalized application rate based on a logical unit treatment such as acres, a maximum value is generally used (lb ai/A); and
Daily Acres Treated = Normalized application area based on a logical unit treatment such as acres(

A/day).

Daily dermal and inhalation doses were then calculated by normalizing the daily dermal and inhalation exposure values by body weight. For occupational handlers using etridiazole, a body weight of 60 kg was used for determining short-term MOEs because the short-term dermal and inhalation endpoints were based on a developmental study; 70 kg (average adult body weight) was used for intermediate and long-term exposure scenarios because the toxic endpoint was not sex-specific.

Since the toxicity endpoints are based on oral studies, [and etridiazole is caustic when applied to skin], a dermal absorption factor of 100% is assumed. Absorbed dermal and inhalation doses for all durations were calculated using the following formula:

$$\text{Potential Daily Dose}\left(\frac{\text{mg ai}}{\text{kg/day}}\right) = \text{Daily Exposure}\left(\text{mg ai /day}\right) * \left(\frac{1}{\text{body weight (kg)}}\right)$$

Once the route specific daily doses are calculated, the Margin of Exposures (MOEs) are calculated as follows:

$$\text{MOE (unitless)} = \frac{\text{NOAEL (mg / kg / day)}}{\text{Daily Dose (mg / kg / day)}} * \text{Absorption Factor (100\%)}$$

* NOAEL and the Daily Dose are for the same route of exposure (i.e. both inhalation or dermal).

Since the dermal and inhalation toxicity endpoints are the same for the same exposure durations the route-specific MOEs can be combined to express a total MOE for the occupational scenario:

$$\text{MOE}_{\textit{(short and intermediate term, dermal and inhalation)}} = \frac{1}{\frac{1}{\text{MOE}\textit{dermal}} + \frac{1}{\text{MOE}\textit{inhalation}}}$$

The following assumptions and factors were used in order to complete this exposure assessment:

- Average work day interval represents an 8 hour workday (e.g., the acres treated or volume of spray solution prepared in a typical day). For example, groundboom applications in an agricultural setting are based upon an 80 acre day because HED believes it normally takes 8 hours to complete that type of application with common equipment. On the other hand, groundboom applications on golfcourse turf are based upon treating 40 acres, because 40 acres represent a 36 hole golfcourse (accounts for approximately 10

percent of all golfcourses in the United States). The 40 acres assumption is not likely the maximum which can be treated on a single day; however, the 40 acres assumption is based upon the fact that an applicator would only treat any given golfcourse one single time on any given day. Other exceptions:

- potting (post-application) activities are assumed to be equal to potting soil for 4 hours as in the registrant-submitted study.
- mowing golf course turf is anticipated to last 4 hours per day.
- the amount of soil-drench applied per day by chemigation or high-pressure hand wand is based on mixing and applying 1000 gallons (rationale:this is an HED default value and label instructions state 200 ft^2 may be covered for each 100 gallons mixed, and 2000 ft^2 is a reasonable area to cover in one day).
- the default daily application rate for mixing, loading, and applying soil drench by low-pressure hand wand is 40-50 gallons/day.
- Daily acres and volumes (as appropriate) to be treated in each scenario are shown in appended Table 1.[8]
- Calculations generally reflect a range of application rates for specific crops recommended by the available etridiazole labels to assess risk levels associated with the various use patterns. The use data provided by the registrant concerning the "typical" application rates that are commonly used for etridiazole were also considered and used where appropriate.
- Due to a lack of scenario-specific data HED often calculates unit exposure values using generic protection factors (PF) that are applied to represent various risk mitigation options (i.e., the use of Personal Protection Equipment (PPE) and engineering controls). PPE protection factors include those representing a double layer of clothing (50 percent PF), chemical resistant gloves (90 percent PF) and respiratory protection (98 percent PF) for use of an organic vapor respirator. Engineering controls are generally assigned a PF of 98 percent.
- For short- and intermediate-term occupational exposure scenarios, an MOE of 100 (10x for intra-species and 10x for interspecies variability) is adequate. There are no anticipated long-term exposures for handlers.
- For the cancer assessment, the scenarios represent: 1) typical exposures (eg., typical application rates) experienced by growers who apply etridiazole to their own fields, greenhouse, golf course, etc., and 2) a multiplier of up to ten times the number of applications per season which represents typical exposures experienced by commercial handlers. Because greenhouses, nurseries, and golf courses usually have their own certified pesticide applicators, a lower multiplier such as 3x was used to represent the range from small to large operations.
- For the cancer assessment, it was also assumed that workers are exposed for 35 years over a 70 year lifetime (non-occupational golfer exposure length is 50 years).

2.1.3 Handler Exposure Data Sources

Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted to the Agency in support of the reregistration of etridiazole. It is the policy of the HED to use data from the Pesticide Handlers Exposure Database (PHED) Version 1.1 to assess handler exposures for regulatory actions when chemical-specific monitoring data are not available.[9] However, some use scenarios exist for etridiazole which are not well represented by the PHED surrogate chemical database.

One of the use scenarios for which there is no chemical-specific handler data is the preparation of treated soil by the addition of wettable powder or granular etridiazole. A Uniroyal-sponsored study of greenhouse worker exposure to potting soil treated with Terrazole was submitted, but the handler exposure was not measured. Therefore, the Agency's best estimate of exposure is to use the PHED surrogate data for mixer/loader of wettable powder or granular formulation, as shown in Table 1 and appended Tables 4-6.

The greenhouse worker study findings indicated two-thirds of the soil handlers' exposure was from inhalation.[10] The vapor pressure of Terrazole technical grade is 0.0107 mm Hg (MRID 429122-08), which is relatively high and may cause default inhalation values to underestimate exposure. Therefore, mixer/loaders of all etridiazole formulations should continue to use dust/mist respirators when loading outdoors, and use organic vapor filter cartridge respirators when in enclosed areas. An engineered local exhaust system should be installed wherever frequent indoor exposures are anticipated.

The Agency has no surrogate exposure data, and hence no defaults, for seed treatment. Therefore the Agency requested permission from Uniroyal to use a seed treatment worker exposure study (MRID 447315-01)[11] which was submitted for the reregistration of another Uniroyal product (Vitavax®). The exposure data from this study, which are reviewed under a separate document,[12] were adjusted for liquid formulation etridiazole application rates and used to predict worker exposures and risks in a commercial seed treatment setting (Table 2). Peanuts were used for the risk assessment as BEAD has noted this is a current use crop. Note that while the Vitavax study showed less than 1% of dose attributable to inhalation, the etridiazole-specific soil handling study showed that 70% of the total dose was due to inhalation. Therefore, the inhalation component of this scenario may be significantly underestimated. There were no data for application of a dust in a commercial seed treatment setting, so the PHED values for mixing and loading wettable powders were used as a surrogate and results are included in the short- and intermediate-term handler exposure tables (Tables 4 and 5). "Typical" volumes of seed treated per day were estimated based on the *average* amount handled by current equipment, using current label rates, study data, Registrant information, and the median of 6 hours per day performing commercial seed treatment. "High" volume estimates used the same data but manufacturer's high range of equipment capacity.

On-farm seed treatment is considered by most sources to represent a relatively small proportion of the total use of treated seed in the U.S., owing to the greater time, labor, and equipment commitment required compared to use of commercially treated seed. However, an Agency

estimate of the on-farm percent of treatment is approximately 20% of the total market, so an exposure assessment is indicated. The only applicable study available to HED was conducted by Fenske, et al., and published in 1990.[13] Fenske, et al., monitored 12 workers (in a total of 60 exposure periods) treating seed by hand using a dust formulation of Lindane insecticide. There are currently available enclosed systems for treating seed on farm, so a range of exposure will be presented based on mixing/loading using PHED values for wettable powder and treating seed with dust by hand using the Fenske study values (see appended Table 3). The combined dermal and inhalation exposure estimated by Fenske, adjusted to lb ai handled, was 10.4 mg/lb ai. Weights and measures for cotton seed and seed treatment (TerraClor Super X 20-5) rates from the September 28, 1998 SMART meeting have been used to represent a typical use scenario. The Fenske study indicated that each worker could load seed into a 12 bushel grain drill (planting machinery) and mix in a dust seed treatment, each treatment requiring about 5 minutes. The Uniroyal document states that cotton may be planted at 18 lb seed/acre, and HED estimates as much as 80 acres may be planted in a day, or 1440 lbs of seed treated per day. Therefore the worker would handle 0.72 lb ai per day, for an exposure of:
0.72 lb ai/day x 10.4 mg/lb ai = 7.5 mg/day. This value is closely correlated with the hourly rate of exposure estimated by Fenske et al.

Other handler exposure estimates were made using the PHED. The PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts: a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates).

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Table 1. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments.[3]

There are three basic risk mitigation approaches considered appropriate for controlling occupational exposures. These include administrative controls (such as decreasing the application rate), the use of personal protective equipment or PPE and the use of engineering controls. Occupational handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to

achieve an appropriate margin of exposure or cancer risk. [Note: administrative controls available generally involve altering application rates for handler exposure scenarios. these are typically not utilized for completing handler exposure assessments because of the negotiation requirements with registrants.] The baseline clothing/PPE ensemble for occupational exposure scenarios is generally an individual wearing long pants, a long-sleeved shirt, no gloves and no respirator. The first level of mitigation generally applied is PPE. As reflected in the calculations included herein, PPE involves the use of an additional layer of clothing, chemical-resistant gloves and a respirator (or the least additional PPE, such as a pair of gloves, which provides an adequate MOE). The next level of mitigation considered in the risk assessment process is the use of appropriate engineering controls which, by design, attempt to eliminate the possibility of human exposure. Examples of commonly used engineering controls include closed tractor cabs, closed mixing/loading/transfer systems, and water-soluble packets.

2.1.4 Handler Exposure and Non-Cancer Risk Estimates

The risk assessment that has been completed for the occupational handler scenarios is presented in Tables 4 through 8. HED anticipates that etridiazole occupational exposures will only occur in a short-term or intermediate-term pattern. HED defines chronic exposures as use of the chemical for greater than 180 days per year and it is anticipated that etridiazole will not be used in this manner. [Note: Readers are cautioned to consider the merits of each exposure scenario when reviewing these tables as risk mitigation options are not universally applicable in all settings (e.g., there are no feasible engineering controls for exposure during hand wand application)].

2.1.5 Short-term and Intermediate-term Dermal and Inhalation Handler Exposure Assessment

The appended Tables 1 and 4-8 include all of the information required to calculate MOEs such as the acres treated per day (A/day), application rate (lb ai/A) and the dermal and inhalation unit exposures for each occupational handler exposure scenario at each level of mitigation (i.e., a single layer of clothing -- long-pants and long-sleeved shirts; no chemical resistant gloves and no respiratory protection, PPE use, and engineering controls). Separate MOEs were calculated for dermal and inhalation by comparing the NOAEL to the relevant daily dose level. Since both dermal and inhalation risk assessments use the same dose/endpoint for short-term and intermediate-term exposure scenarios, the MOEs are based on the sum of the dermal and inhalation doses for each period. As a result, only a single MOE value is presented for both the dermal and inhalation exposure scenarios for each period. A MOE of 100 or greater is adequate for short- or intermediate-term exposures. A MOE of 100 or greater does not exceed HED's level of concern and further mitigation is not required (i.e., the risk mitigation is not increased).

In cases where the risk assessment indicated an unacceptable level of risk at the baseline clothing scenario (i.e., MOE <100), HED applied varying levels of mitigation to each scenario until either

an acceptable level of risk was attained or an exhaustive level of risk mitigation was applied and an acceptable level of risk could not be attained. Tables 4 and 5 contain the baseline clothing risk assessment (MOEs) for the short- and intermediate-term exposure scenario calculations, respectively. Tables 4 and 5 include the risk assessments that were completed for etridiazole at increasing levels of risk mitigation. Table 6 estimates the cancer risk for all levels of handler protection or engineering control, where available. As indicated above, risk mitigation options used by HED for occupational pesticide handlers include (1) the use of PPE (Personal Protective Equipment) that includes an additional layer of clothing, chemical resistant gloves, and respiratory protection (or the least additional PPE to afford the required protective MOE); and (2) the use of appropriate engineering controls. The risk assessments were completed for handlers using no gloves, then wearing single-layer PPE and chemical-resistant gloves (typical label PPE), using a second layer (i.e., coveralls over work clothes) of PPE, gloves, and an organic-vapor respirator, and finally, using engineering controls (with single-layer clothing).

Table 1 summarizes the caveats and parameters specific to the data used for each exposure scenario. These caveats include descriptions of the source of the data and an assessment of the overall quality of the data. Generally, the assessment of data quality is based on the number of observations and the available quality control data. Quality control data are assessed based on grading criteria established by the PHED Task Force. Additionally, it should be noted that all calculations were completed based on current HED policies pertaining to the completion of occupational and residential exposure/risk assessments (e.g., rounding, exposure factors, and acceptable data sources).

Margins of Exposure (MOEs) are used to determine if the use of a chemical is of concern. MOEs are also used to evaluate a chemical via various application methods, application rates, daily treatment of acreage and use of mitigation measures (when feasible). The only long-term occupational exposures are expected to be for post-application exposure to treated soil, as in a greenhouse or nursery. Therefore, for etridiazole handlers (loaders and applicators), an MOE greater than or equal to 100 does not exceed HED's level of concern. Short-term and intermediate-term dermal and inhalation MOEs were calculated for each scenario before combined ST and IT MOEs were determined (Tables 4-7).

Risks for handlers were assessed using the short-term and intermediate-term toxicological endpoints. Results from each assessment are presented below.

2.1.6 Combined Dermal and Inhalation Risks

The combined baseline (single layer of clothing) dermal and inhalation MOEs ranged from 0.79 to 290,000 for short-term, and from 0.29 to 110,000 for intermediate-term exposure. Twenty-two of 56 short-term exposure scenarios at baseline had combined-route MOEs less than 100, while 29 intermediate-term scenarios had MOEs below 100. With the addition of gloves, MOEs ranged from 5.5 to 3.3 x 10^5 for short-term, and from 2.1 to 1.3 x 10^5 for intermediate-term exposure. With gloves, 14 of 56 short-term exposure scenarios had MOEs below 100, and 20 of 56

intermediate-term scenarios MOEs were below 100. Of the scenarios which did not exceed an MOE of 100 with gloves, additional coveralls and organic-vapor respirator use increased the MOE to greater than 100 for none of the short-term (range 8.9-6300) and two intermediate-term (range 3.3 to 120) scenarios. Engineering controls were applied to the remaining 18 scenarios where feasible, but 11 were not feasible. Ten short-term and 8 intermediate-term scenarios had MOEs greater than 100 with engineering controls, with a range of 190-4300 for short-term and 71-1600 for intermediate-term scenarios.

Short-term Combined Dermal and Inhalation Risk Estimates

The MOE uncertainty factor = 100; the following scenarios are presented which have combined short-term dermal and inhalation MOEs greater than or equal to 100. Scenarios which are not listed did not have feasible control methods to adequately reduce risk and are discussed following this section.

Baseline

(1b) Mixing and loading wettable powder for chemigation application (all rates).
(2) Loading granular formulation for in-furrow soil application (all rates).
(3b) Mixing and loading liquid formulation for on-farm seed treatment (all rates).
(3d) Commercial seed treatment using liquid: seed bag handler (typical, high rates).
(5a) Applying to turf/golf course with groundboom sprayer (all rates).
(5b) Applying liquid to soil in-furrow (all rates).
(6) Loading and applying granules to soil in-furrow (all rates).
(7) Mixing, loading and applying EC/FC (liquid) formulation to soil in-furrow (low/typical rates).
(9) Mixing, loading, and applying EC/FC (liquid) as a drench using low pressure hand wand (typical rate).
(10) Mixing, loading, and applying EC/FC (liquid) using high-pressure hand wand for drench (typical rate).
(13) Loading and applying granules (1.3%) to golf course turf using tractor-pulled spreader (typical rate).
(15) Loading and applying granules to potting soil (high rate).
(16) Loading and applying wettable powder to potting soil (high rate).
(21) Loading and applying granules (8%) to soil using tractor-pulled spreader (typical rate).
(22) Loading and applying granules (5%) to soil using tractor-pulled spreader (typical rate).

Single-layer PPE with Gloves

(3a) Mixing and loading liquid formulation for application to soil in-furrow (all rates).
(3c) Commercial seed treatment using liquid formulation: loader/applicator (typical rate).
(4) Loading dust for commercial seed treatment (low/typical rate).
(7) Mixing, loading and applying EC/FC (liquid) formulation to soil in-furrow (all rates).
(8) Mixing, loading and applying dust as a seed treatment in hopper box (study data).

Double Layer of Clothing and Organic Vapor Respirator

No additional scenarios had MOEs greater than 100.

Engineering Controls

(1a) Mixing and loading wettable powder for turf/golf course groundboom application (all rates).
(4) Loading dust (surrogate WP data) for commercial seed treatment (all rates)
(14) Mixing, loading, and applying WP in water-soluble bag to golf course turf using groundboom (all rates).

Scenarios for Which MOEs Do Not Exceed 100 with Maximum Controls

(11) Loading and applying granules (1.3G) to golf course turf using belly grinder (typical rate).
(12) Loading and applying granules (1.3G) to golf course turf using push-type spreader (typical rate).
(15) Loading and applying granules to potting soil (high rate).
(17) Loading and applying granules (8G) to soil using belly grinder (typical rate).
(18) Loading and applying granules (5G) to soil using belly grinder (typical rate).
(19) Loading and applying granules (5G) to soil using push-type spreader (typical rate).
(20) Loading and applying granules (8G) to soil using push-type spreader (typical rate).
(24) Dispersing granules by hand.

There are **no data** for one scenario at any level of exposure:
(23) Loading and applying granules using a power dust blower.

Intermediate-term Combined Dermal and Inhalation Risk Estimates

The MOE uncertainty factor =100 for intermediate-term exposures; all of the same (above) scenarios had MOEs greater than or equal to 100 for intermediate-term, except for the following changes:

Baseline:
Scenarios with MOEs *less* than 100:
(3d) Commercial seed treatment using liquid (seed bag handler).
(5a) Applying to turf/golf course with groundboom sprayer (high rate).
(9) Mixing, loading, and applying EC/FC (liquid) as a drench using low pressure hand wand (typical rate).

Single-layer PPE with Gloves

Additional Scenarios with MOEs equal to or greater than 100, including those listed for short-term exposure risk estimates:
(1b) Mixing and loading wettable powder for chemigation application. (typical/high rates).
(9) Mixing, loading, and applying EC/FC (liquid) as a drench using low pressure hand wand (typical rate).

Double Layer of Clothing and Organic Vapor Respirator
Additional scenarios with MOEs equal to or greater than 100, including those listed for short-term exposure risk estimates:
(4) Loading dust (wettable powder surrogate) for commercial seed treatment (low rate).
(5a) Applying to turf/golf course with groundboom sprayer (high rate).

Engineering Controls (Closed Mixing/loading, Wettable Powder in Water-Soluble Bag)
No other scenarios had MOEs greater than 100 than those listed for short-term exposure risk estimates.

Scenarios For Which No Feasible Controls Currently Exist:

Low-pressure handwand sprayer
High-pressure handwand sprayer
Loading and/or applying granular formulation (not available at this time)
Loading and/or applying dust formulation (not available at this time)

There are currently no feasible engineering controls for the above-listed situations, which include the scenarios which did not have MOEs greater than 100 with maximum protection or controls. Therefore the only ways to reduce worker exposure are to use a different method, such as chemigation instead of hand drenching, or to reduce the amount of active ingredient applied. Closed loading systems are a solution in some cases, providing approximately 98% reduction in exposure for the loader, but are not currently available for etridiazole granules or dusts, and are not generally available for the small-scale granular or dust application methods. Note also that there are no known enclosed-cab type of golf course turf application equipment.

2.1.7 Handler Dermal and Inhalation Cancer Risk Assessment

On August 29, 1990, the Carcinogenicity Peer Review Committee classified Terrazole as a Group B_2 - probable human carcinogen (based on liver tumors in male rats) and determined that the most potent unit risk or Q_1^* is 3.33×10^{-2} $(mg/kg/day)^{-1}$ in human equivalents. A 100 percent absorption factor is assumed for both the dermal and inhalation exposure routes in this risk assessment. If a cancer risk estimate which incorporates both dermal and inhalation exposures is 10^{-4} or lower for occupationally-exposed populations, the current Agency policy states that "OPP will continue to carefully evaluate pesticides with risks in this range [10^{-6} to 10^{-4}] and will seek

ways to reduce individual cancer risks to the greatest extent feasible, preferably to 10^{-6} or less" (D. Barolo memo 8/14/96). Therefore, a cancer risk assessment was done accounting for handler exposures via dermal and inhalation routes and inclusive of all known methods of exposure reduction.

When a cancer risk estimate is quantified using a Q_1*, risk is expressed as a probability. For example, the probability frequently considered to represent an acceptable risk level for the general population is 1×10^{-6} (one in a million). When this approach is used, the implicit assumptions are that any exposure will lead to some level of risk and that risk is directly and linearly proportional to exposure, regardless of the dosing schedule.

Average Daily Doses (ADDs) were calculated for baseline, PPE, and engineering controls for each exposure scenario when data were available from chemical-specific studies or PHED. The daily dermal and inhalation doses found in Tables 4-6 were used to calculate ADDs. When ADDs are calculated, the doses for each exposure route are summed. Once the Average Daily Dose is calculated, a Lifetime Average Daily Dose (LADD) can be calculated. To obtain the cancer risk estimate associated with a specific exposure scenario, the LADD is multiplied by Q_1*.

Average Daily Dose is calculated:

Average Daily Dose (mg/kg/day) =

Potential daily dose$_{Dermal}$ (mg/kg/day) + Potential daily dose$_{Inhalation}$ (mg/kg/day)

Lifetime Average Daily Dose is calculated:

Lifetime Average Daily Dose (mg/kg/day) =

Average Daily Dose (mg/kg/day) x (days worked/365 days per year) x (35 years worked/70 year lifetime)

Cancer Risk is calculated:

Cancer Risk = LADD (mg/kg/day) x Q_1^* $(mg/kg/day)^{-1}$

2.1.8 Handler Dermal and Inhalation Cancer Risk Summary

The Average Daily Doses (ADD) of baseline, PPE and engineering controls are presented for each exposure scenario in the appended Tables 4-6. The lifetime average daily dose and

cancer risk estimate values are also calculated for each exposure scenario. The number of treatments per crop per season were used to determine application frequency for private handlers and commercial handlers.

Combined Dermal and Inhalation Cancer Risks

The following two tables and descriptions summarize regular handler and commercial handler cancer risk estimates for all etridiazole exposure scenarios in this risk assessment. Exposure scenarios for which combined dermal and inhalation cancer risk estimates exceed 1×10^{-4} are presented.

Using double-layer protective clothing and an organic vapor cartridge respirator, for typical application rates, four scenarios for applying granules to soil using different equipment had cancer risk estimates greater than 1×10^{-4} for single site operations. With the same PPE, eight different types of commercial handler scenarios had cancer risk estimates greater than 1×10^{-4}. At the highest level of mitigation available, using water-soluble packaging for wettable powders where applicable, none of the private or commercial handler exposure scenarios for which controls were possible yielded cancer risk estimates greater than 1×10^{-4}. However, there were six scenarios that lacked such a control method and had risk estimates greater than 1×10^{-4}. There were no data for the granule blower scenario.

Private (Non Commercial Applicator) Handlers Table

Private (Single-Site) Handler Scenario	Lowest Cancer Risk Estimate	Highest Cancer Risk Estimate
Baseline	$6.2\ 10^{-9}$	$2.0\ 10^{-3}$
Single-layer PPE + Gloves	$5.3\ 10^{-9}$	$3.2\ 10^{-4}$
Double-layer PPE + Respirator	$2.9\ 10^{-8}$	$2.0\ 10^{-4}$
Engineering Controls	$2.9\ 10^{-8}$	$7.8\ 10^{-6}$

Assuming typical application rates. Reference Attachment Table 6.

Commercial Handlers Table

Commercial Handler Scenario	Lowest Cancer Risk Estimate	Highest Cancer Risk Estimate
Baseline	$1.9\ 10^{-8}$	$6.0\ 10^{-3}$
Single-layer PPE + Gloves	$1.6\ 10^{-8}$	$9.6\ 10^{-4}$
Double-layer PPE + Respirator	$8.6\ 10^{-8}$	$5.9\ 10^{-4}$
Engineering Controls	$2.9\ 10^{-7}$	$3.9\ 10^{-5}$

Assuming typical application rates; frequency increased to represent commercial application. Reference Attachment Table 6.

2.1.9 Summary of Risk Concerns for Handlers, Data Gaps, and Confidence in Exposure and Risk Estimates

A margin of exposure (MOE) of 100 or greater for short- and intermediate-term occupational exposure does not exceed HED's level of concern. About 40% (22 of 53) of the short-term and half (29 of 53) of the intermediate-term exposure risk assessments for etridiazole handler scenarios exceeded the level of concern with only a single layer of clothing. Only by use of additional personal protective equipment (PPE) or engineering controls were most MOEs elevated to at least 100. Typical worker clothing is represented by the scenarios with a single layer of work clothes and chemical-resistant gloves. Of the short-term scenarios using single layer clothing with gloves, 14 of 53 had an MOE which still exceeded the level of concern of 100. Of 53 intermediate-term exposure scenarios with single layer PPE and gloves, 20 had MOEs below 100, which exceeds the level of concern. An additional layer of clothing and respiratory protection had very little effect on short-term MOEs, and effectively raised only one short-term and two intermediate-term scenarios above the minimum MOE of 100. As these values are based on chemical surrogate data with lower vapor pressures, the effect of adding respiratory protection would probably be greater than indicated, but the baseline inhalation exposure would also be greater. Double-layer clothing, or coveralls over work clothes, and respirators also add the risk of heat stress and decrease range of motion, visibility, and communication. Therefore engineering controls are preferred to additional PPE. The engineering control which was applicable to most scenarios was a water soluble bag for the wettable powder. Currently, the WSB is not available for etridiazole. Also, for several scenarios which are common in nursery and turf work, there were no feasible engineering controls. All of these involved application of granular formulation by various means. An enclosed system for handling and loading granular products would be desirable to reduce handler exposure, but is also not available at this time. The hand-held application methods have no known engineering controls, but some may be replaced by use of chemigation. There is a lack of data for dust exposures.

Worker cancer risks were estimated for private and commercial handlers using *typical* application rates. Baseline (no glove, single layer of clothing) cancer risks exceeded 10^{-4} in one-third (10 of 34) of private and one-half of commercial (15 of 34) applicator scenarios. Cancer risks exceeded 1.0×10^{-4} for one-quarter (9 of 34) of "private" or non-commercial applicator exposure scenarios, where workers wore a single layer of clothing and chemical-resistant gloves. For commercial applicators wearing the same protective equipment, one third (12 of 34) had cancer risk estimates greater than 1.0×10^{-4}. By using additional PPE and/or engineering controls, all handler scenarios cancer risks were reduced below 1.0×10^{-4}, except for those application methods (six scenarios) which had no known method of engineering control or no data (2 scenarios). Again, most of these were the scenarios involving application of granular products to turf and soil, discussed above.

As stated earlier, the data for seed treatment exposure from any source are very limited, and of fairly high uncertainty. There is also no specific data on soil incorporated liquids and granules, probably owing to the general presumption that these scenarios result in minimal exposures. The surrogate PHED scenarios used for soil-incorporated applications are therefore considered to be an over-estimate of anticipated exposures.

In general, there is very little data available on any hand applications of pesticide in dust formulations. Specifically, a data gap exists for on-farm handling of dust for seed treatment without gloves (the amount on the outside of the gloves could be a surrogate, but that information was not available from the study used). Other 'dust' scenarios used data from studies of wettable powders as a surrogate. Also, there is no non-proprietary information available for closed mixing/loading systems for granular products. This information would be useful in mitigating those risks by engineering controls.

Due to the relatively high vapor pressure of etridiazole, and the data from the submitted soil handling study which indicate the majority of soil handler exposure was by the inhalation route, the HED is concerned about handler exposure to etridiazole, particularly in enclosed areas, such as greenhouses. The following data is required:

- Product chemistry data to determine the vapor pressure of the dry formulations, in order to determine if handling dry formulations also present a significant respiratory hazard.
- 875.1200 Guideline applicator study data for dermal exposure: indoors
- 875.1400 Guideline applicator study data for inhalation exposure: indoors

2.2 Post-Application Exposure and Risks

HED is concerned about potential occupational post-application exposure to etridiazole from handling or other contact with treated soil or seeds. Contact with soil after in-furrow application

is considered unlikely or minimal. Based on typical activities in greenhouses and nurseries, contact with treated soil is likely. Uniroyal submitted 4 residue studies (including one greenhouse worker exposure study) that address the dissipation of etridiazole on turf and soil. The studies are reviewed in detail in Section 2.2.2 Post Application Exposure Data Sources.

2.2.1 Post-Application Exposure: Assumptions

The calculations used to estimate *Daily Dermal Dose* and *MOE* for the dermal post-application scenarios are similar to those described above for the handler scenarios. The only significant differences are: (1) the manner in which the *Daily Dermal Dose* is calculated using transfer coefficient, transferable residue levels, and accounting for the dissipation of etridiazole over time; and (2) inhalation exposures were not calculated for most post-application scenarios (i.e., *Total Daily Dose* in the *MOE* calculation only represents dose levels resulting from dermal exposures because the data reflect inhalation exposures which have been shown historically to account for a negligible percentage of the overall body burden). However, due to the higher vapor pressure of etridiazole, relative to other pesticides and fungicides, and because the post-application study of greenhouse workers using treated soil found inhalation exposure to be a significant portion of their total dose, inhalation exposure will be considered a contributor to that exposure scenario. Inhalation will also be considered for exposure to handling treated seed. Margins of exposure of 100 or greater for short- and intermediate-term and 300 or greater for long-term post-application exposure do not exceed HED's level of concern.

Because etridiazole is designed to act in the soil, or "soil-incorporated," post-application agricultural exposure is considered to be negligible as long as the soil is not directly contacted. The exception is farmers handling treated seed. Heretofore it was assumed that exposure to treated seed, which has been stored for an indefinite time before use, represented a minimal exposure hazard to the handler. An estimate of the inherent risk from treated seed was conducted for descriptive purposes using relatively conservative assumptions. The results should be used only for determining a comparative range of exposure. As there are no study data available on exposure to fungicide residue on treated seed, the exposure has been estimated in the following manner. It is assumed that the total amount of etridiazole applied to the seed is available and the unit exposure for handling granular formulations in PHED is used to determine the dose. In other words:

PHED unit exposure (mg/lb ai handled) x Application rate/lb seed x seed handled (lb/day) = dose (mg ai/day)

Cotton was chosen for estimating exposure during seed handling while planting. Therefore the same volume (1440 lbs/80 acres/day) and rates (0.05-0.0625 lb ai/100 lb seed) were used as in the on-farm seed treatment scenario. For this exposure estimate, handlers were assumed to wear a single layer of clothing without gloves.

In plant nurseries and greenhouses the treated soil may be contacted frequently and throughout the year. When it is applied to golf course turf, some residue remains on the grass itself, even though it is generally watered in after application, and golf courses are watered frequently (often

daily).

The typical occupational work day interval is generally considered to be 8 hours, however the best available information indicates activities such as mowing and turf maintenance typically last 4 hours per day. Greenhouse or nursery workers handling treated soil (eg., potting, transplanting) post-application of etridiazole have an estimated exposure duration of 4 hours per day. Additionally, the 4 hour value is also used to estimate the duration of a game of golf (18 holes). Because a turf transferable residue (TTR) study was conducted, the residue value from the study can be used to determine the post-application dose:

Dermal dose is calculated:

Dermal dose (mg ai/kg/day) =

(TTR(t) [μg/cm^2] x Tc (cm^2/hr) x DA x 0.001 mg/μg conversion x # hours worked/day) / body weight (kg)

Where:

Dermal dose (t) = dermal dose attributable to exposure at time (t) when engaged in a specific mechanical activity or job function (mg ai/kg/day);
Turf transferable residue (TTR) = transferable residue that represents the amount of residue on turf that is available for dermal exposure at time (t) [μg/cm^2]; as defined above;
Tc = transfer coefficient or measure of the relationship of exposure to transferable residue concentrations while engaged in a specific mechanical activity or job function; transfer coefficients of 1000 and 500 were assumed for push-type mowers and tractors, respectively;
DA = dermal absorption (%);100% dermal absorption was assumed;
Hours worked/day = exposure duration or hours engaged in specific mechanical activity (hrs/day); and
Body weight = body weight (kg) (60 kg for short-term exposure; 70 kg for intermediate and long-term and cancer risk.

2.2.2 Post-Application Exposure: Data Sources

Chemical-Specific Studies

Three post-application studies were submitted to the Agency; a "Magnitude of the residue" study; a "transfer of the residue" study; and a greenhouse worker exposure/soil dissipation combined study (in place of two guideline studies). The studies and results are discussed below.

Magnitude of Residue Study

A study of residue dissipation after initial and repeated application of Terrazole® 35 WP Fungicide to turf (MRID #432878-01)[14] was submitted in support of the etridiazole Data Call-In (DCI) notice of July 2, 1991. The study was reviewed and compared to the EPA OPPT Series 875.2100 Post-Application Exposure Monitoring Test Guidelines requirements.[15] The study partially met the Guideline criteria. However, the study results were largely unacceptable because

of deficits in study design. Only the relative magnitude of the residues may be considered from the data.

The study consisted of planting Bermuda Grass on a study plot, mowing it every 2 days, and applying the etridiazole. Magnitude of residue samples were taken at 0, 6, and 12 hours after initial application, then at 1, 3, 5, 7, 10,12, 15, 18, 20, 25, and 30 days. A total of 54 samples of turf were collected by cutting the grass at the soil line. A minimum of ½ lb untreated and 1/4 lb treated turf were collected for each sample.

Field data were collected in November and December of 1993 on the island of Hawaii. Hexane was used to extract the etridiazole from the turf clippings. Also, rather than shaking the solution to dislodge residues, as stated in the Guidelines, the samples were homogenized. The results of the analyses showed that the residues ranged from 320 ppm at 0 hours after application number 1 to about 70 ppm at 6 hours to about 0.2 ppm at 30 days after the first application (15 days after the fourth application). Because the analyses did not measure dislodgeable foliar residue, but rather, total residue of the grass clippings, this study is not useful in determining actual occupational or non-occupational exposures. However, it is useful to note that the total residue determined by this method always diminished by half within 6 hours and to 1-2 ppm within 5 days post application, indicating a short (less than 6 hours) half-life and a lack of accumulation when applied as labeled.

Transfer of Residue Study

A study of residue transfer after initial and repeated application of Terrazole® 35 WP Fungicide to turf (MRID#432878-02)[16] was submitted in support of the Terrazole Data Call-In (DCI) notice. Although residues on turf are not typically required, the author states this study has been submitted to the U.S. Environmental Protection Agency (EPA) to demonstrate that transferable residues are less than the expected levels. The study was reviewed and compared to the EPA OPPT Series 875.2100 (Post-Application Exposure Monitoring Test Guidelines). The study partially met the Guideline criteria. However, the measured transferable residues were mostly below the laboratory level of quantitation (LOQ) and therefore provide mostly negative information (eg., the study shows only the upward bounds of residue transfer, not the lower levels). EPA found the study data inadequate due to insufficiently low LOQ.

The Terrazole WP was applied at an initial rate of 8 oz product (2.8 oz ai)/1000 square feet and followed by applications at 4.5 oz product (1.6 oz ai)/1000 sq. ft. each, every five days thereafter.

The study consisted of planting Bermuda Grass on a study plot, mowing it every 2 days, and applying the etridiazole. Transferable residue samples were taken at 0, 6, and 12 hours after initial application, then at 1, 3, 5, 7, 10,12, 15, 18, 20, 25, and 30 days. A total of 60 samples were collected on cloth dosimeters: the cotton cloths were covered with plastic and a 12 kg. weighted roller was rolled back and forth over the cloth ten times. Control samples were collected only once, at the beginning of the study. Analysis results were corrected for fortification

recovery rates.

Field data were collected in November and December of 1993 on the island of Hawaii. The results of the analyses of the dosimeters showed that the transferable residues were mostly (53/60) nondetectable. The highest residue detected was 0.13 $\mu g/cm^2$, immediately post-application on the first application (this was at the highest rate), but two simultaneous samples found levels at the limit of quantitation. Only three other samples out of sixty were above the limit of quantitation for the laboratory analysis method. Those were 0.06 $\mu g/cm^2$ immediately after the second application (5 days), and 0.10 and 0.11 $\mu g/cm^2$, both immediately after the third application. The Agency estimated a transferable residue of 4.3 $\mu g/cm$ based on 5% of the application rate (default transfer factor). Therefore the study residue level represents about 0.2% of the application rate, which is low but within the range of potential exposures anticipated from contact with turf, based on other similar studies. These exposure estimates are shown in Table 7.

Greenhouse Worker/Soil Residue Study

A study of dermal and inhalation etridiazole exposure to workers using potting soil and soil residue dissipation after application of Terrazole® 35 WP and Truban® 5G Granular Fungicide to potting soil in a greenhouse (MRID#442278-01) was submitted. This study partially met the requirement in OPPTS Series 875 of the Occupational and Residential Exposure Test Guidelines (U.S. EPA 1997). The field data presented in this study are based upon well-documented procedures with adequate quality controls. This data can be useful in determining exposures to etridiazole-containing compounds in the greenhouse setting, particularly given the general dearth of data specific to this exposure.

The study used four volunteer workers to fill plastic pots with soil treated with Terrazole® 35 WP (wettable powder) in three re-entry scenarios and Truban® 5G Granular in one other scenario. The study consisted of 15 replicates, and each replicate consisted of one worker filling the plastic pots with treated soil inside a greenhouse. Four replicates were obtained at four hours post-application, four at 12 hours post-application, and three at 24 hours post-application of the Terrazole. Four replicates were obtained at 4 hours post-application of the Truban. Field data were collected from December 16, 17 and 18, 1996 in a commercial greenhouse in Half Moon Bay, California.

Dermal exposure was assessed by analyzing an whole-body dosimeter consisting of a cotton long underwear worn under work clothing, which consisted of long denim pant and a long-sleeved cotton shirt, shoes and socks. Cotton gauze swabs were used to wipe face and neck. Hand exposure was determined using four 500-ml aliquots of a solution of 0.01 percent Aerosol OT ® (sodium dioctyl sulfosuccinate) in distilled water for two hand washes and rinses. The total dermal exposure, adjusted for field fortification recoveries, and standardized to an 8-hour work day, was 433 μg for 4 hour re-entry post-application of Terrazole 35WP; at 12 hours post-application, 249 μg; and at 24 hours post-application, 310 μg. For Truban 5G, at 4 hours post application, the 8-hour projected dermal exposure, adjusted for field recoveries, was 134 μg.

Inhalation exposure was measured using personal air sampling pumps. The sampling pumps were calibrated to draw 1.5 liters per minute (lpm) and post-calibrated at the end of each sampling period with a Kurz Mass Flow Meter. The sampling train consisted of a cassette containing a mixed cellulose ester filter in series with a glass absorber tube containing XAD sorbent resin, which was attached to the collar of the coveralls near the worker's breathing zone. The average inhalation exposure, adjusted for field recoveries, and standardized to an 8-hour shift, for the 4-hour post application worker exposed to Terrazole 35W was 851 μg; for the 12-hour post application work the eight hour dose was 497 μg; for the 24-hour post application work the eight-hour dose was 768 μg . For Truban 5G 4-hour post application the 8-hour projected exposure was 284 μg. The inhalation dose comprised 70-77 percent of the total dose from inhalation and dermal exposures for either Terrazole 35W or Truban 5G. This information supports the use of conservative estimates for etridiazole handler and post-application exposures as the database used by HED is generally based upon surrogate chemicals which have lower vapor pressures than etridiazole.

This study also measured the dissipation of etridiazole in soil after separate application of Terrazole 35WP and Truban 5G. The authors proposed the development of a transfer factor for dosage of ai, based on the total exposure in micrograms (dermal and inhalation) divided by the dislodge able soil residue (ug/G) yielding a factor of G/hr. Unfortunately, analysis of the data shows that the residue does not decline evenly in a linear or loglinear fashion, and in fact measured residues are greater on the third day than at eight hours after treatment. Using linear regression of the log-transformed data (R^2 = .21) allow examination of the data enough to show that there is very slow decline of the residues in the soil (2%/day), requiring 28 days to decrease by one-half.

2.2.3 Post-Application Exposure and Non-Cancer Risk Estimates

The exposure and risk estimates for post-application exposure to potting soil and turf contact activities are shown in Table 7. Greenhouse or nursery workers are expected to be exposed to the post-application residues of potting soil on a regular basis, for an estimated 4 hours per day. The 12-hour re-entry dose for potting soil handling from the submitted study was used to estimate an MOE of 900 for intermediate or long-term exposures. Different levels of contact with treated turf were estimated, using riding mowing to represent the lower and push mowing the higher range of exposure. It is assumed that the transfer coefficient of 1000 cm^2/hr for push-mowing is inclusive of the limited amount of higher contact activities such as hand trimming performed on the golf course. The MOE for push mowing for intermediate-term duration is 320.

Post-application exposure estimates for farmers and workers handling and loading treated seed for planting are summarized in Table 8. The short-term MOEs ranged from 48,000 to 60,000 based on the treatment rates and estimated acreage for planting cotton seed (80 acres and 1440 lbs of seed, the same parameters as were used previously for mixer/loaders of dust formulation.) The intermediate-term MOEs ranged from 18,000 to 22,000.

These exposure estimates are expected to cover the most common risks that can be anticipated from occupational post-application exposure to etridiazole. The turf study that risk assessments are based on had significant flaws, yet it is felt that this data is more reflective of actual residues than the defaults. Workers in greenhouses could be exposed to soil more than the estimated 120 days per year, but the four-hour exposure estimate and 12-hour dose used in calculating the risk are expected to be conservative enough to cover typical worker activities. It is also assumed that workers will avoid, or have negligible contact with soil-incorporated etridiazole used during planting.

2.2.4 Post-application Exposure and Cancer Risk Estimates

The 12-hour re-entry dose for potting soil handling from the submitted study was used to estimate a cancer risk of 2.9×10^{-5}. The lifetime cancer risk for mowing is estimated at 2.0×10^{-5} to 4.0×10^{-5}, based on the turf residue data. Estimated cancer risks for private farmers handling and planting cotton seed were in the range of 6.8×10^{-8} to 8.4×10^{-8}. Commercial planters (20 days per year) have an estimated cancer risk of 2.0×10^{-7} to 2.4×10^{-7}.

2.2.5 Summary of Occupational Handler Post Application Risk Concerns, Data Gaps, and Confidence in Exposure and Risk Estimates

None of the MOEs for post-application worker scenarios exceeded the Agency's levels of concern. All estimated occupational post-application cancer risks were less than 1×10^{-4}.

The potting soil scenario is believed to be highly conservative, as the worker was potting bare-handed using soil treated only 12 hours previously at the highest label rate for four hours. This scenario should be adequately protective for other soil-contact activities as well, including transplanting and turf maintenance. However, the soil residue dissipation data also show that etridiazole, at least in dry soil, dissipates very slowly. All post-application soil or foliar exposure estimates were based on the submitted studies. The turf transferable residue study, due to the low number of detectable residues and the single location, was considerably weaker than the potting soil study. However, the detectable residues in the turf study (about 0.2%) were all consistently low and not inconsistent with other similar studies. Greenhouse or nursery workers are expected to be exposed to the post-application residues of potting soil on a regular basis (potentially more than six months per year), for an estimated 4 hours per day.

Because PHED values are used for estimating exposure when handling treated seed, and etridiazole has a higher than typical vapor pressure, inhalation exposures may be underestimated. Also, the behavior of the chemical on treated seeds may not be similar to the granular formulation, which is used as the surrogate for seeds. However, since all of the pesticide applied is assumed to be available, and handlers were assumed to be bare-handed, the calculated dose is believed to be adequate for estimating exposure range.

NON-OCCUPATIONAL EXPOSURES AND RISKS

3.1 Residential Handler Exposures and Risks

None of the etridiazole labels have residential uses, so there are no residential handlers.

3.2 Non-Occupational Post-Application Exposure and Risks

3.2.1 Post Application Exposure Scenarios

Non-occupational exposure to etridiazole is most likely to occur on a golf course, where it may be applied repeatedly throughout the year and within a few hours of public usage. The emulsified product is applied by a boom-type sprayer and granules are applied by hand- or push-type spreader. The labels do not indicate any other usage in a public area. While it is most likely that adult golfers could be exposed to etridiazole after application on golf courses, it is possible that younger children, either golfing or accompanying adult golfers could also be exposed. However, a risk assessment for this exposure scenario for the general population, including infants and children, was not conducted since a short-term dermal toxicological endpoint of concern was not identified for the general population. A risk assessment was conducted for female golfers of child-bearing age (13-50 years old) using the developmental NOAEL of 15 mg/kg/day. Because the FQPA Safety Factor Committee determined that the 3x FQPA safety factor does not apply to the acute dietary risk assessment, it is also not applicable to the short-term dermal risk assessment as both assessments are based on the same toxicity study. Therefore, an MOE of 100 or greater is adequate for female golfers 13-50 years old.

Because a chemical-specific study of transferable turf residue was submitted to the Agency, and the data from that study were found to be consistent with other turf studies, the study data were used to determine the health risk presented by post-application entry onto a golf course, and it was not necessary to use the EPA's *SOPs For Residential Exposure Assessments*. The formula for calculation of golfing exposure, however, was from the SOPs. The equations used for the calculations in Table 9 were the same equations as previously presented in the occupational post-application portion of the RED with the following changes:

- ED (exposure duration) in the calculation of daily dose is 4 hours per day for golfers. This is based on the estimated time required to play 18 holes of golf.
- For the purposes of cancer risk assessment, a golfer is assumed to play biweekly, or 26 times per year. This frequency is intended to represent the higher end of amateur golfing but not a maximum.
- The application rate used in the non-occupational assessment is the same as was used for turf workers, which is the maximum rate of 7.6 lb ai/acre.
- Adults including females over 13 years old were assumed to weigh 60 kg for calculation of short-term exposures, including golfing.

- Post-application was assessed on the same day the pesticide is applied because it was assumed that the golf course is open every day and the user could be exposed to soil immediately after application. Therefore, post-application exposures were based on day zero, 12-hour post-application residues.
- Due to a lack of scenario-specific exposure data, HED has calculated exposure values for adults using surrogate dermal transfer coefficients that represent reasonable low (100 cm^2/hour for adult golfing) contact activities.

3.3 Non-Occupational Post-Application Risk Assessments

Because a chemical-specific study of turf residue transfer was submitted by the Registrant, it is not necessary to use the Residential SOP defaults for the residues to assess non-occupational exposure to turf. Using the transferable residue at 12 hours post-application, which is the duration of the current re-entry interval, the MOEs for golfing adults including females 13-50 years of age were determined (see Table 9). For adult golfers, the short-term MOE using the study data is 17,000, which does not exceed HED's level of concern. Cancer risk estimates were determined for all adult golfers. The exposure estimate was derived from the turf transferable residue study data on day of application and assumed a four hour exposure occurring 18 times a year. The frequency and duration of the golfer exposure were based upon information published in 1992.[18] The estimated cancer risk for adult golfers is 8.9×10^{-7}. This estimate was based upon the conservative assumption that the golfer would be exposed each day of play to residues equal to the day of application.

3.4 Post-Application: Data Gaps and Confidence in Exposure and Risk Estimates

This risk assessment assumes that the only significant post-application exposure to etridiazole, based on the types of application, is contact with treated soil, seed or turf. The likely and predictable soil and turf exposures have been estimated for workers and non-workers. The turf transferable residue study had significant weaknesses (discussed above) but was considered adequate for use in this assessment and preferable to the default values provided by the Residential SOPs. This risk assessment can be further refined upon receipt of additional data such as the Agricultural Reentry Task Force data. The post-application treated seed handler exposure assessment was based upon assumptions of 100% available residue and the use of PHED surrogate data. These are considered highly conservative assumptions. Using the available data and surrogate PHED data, none of the post-application scenarios exceeded the Agency's levels of concern.

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APPENDIX TO ETRIDIAZOLE
HANDLER AND POST-APPLICATION EXPOSURE
RISK ASSESSMENT

Tables 1-9

Note:

Explanation of column headings for Etridiazole handler risk assessment tables.

Application rates represent the highest rates (from all labels with that formulation type) for various agricultural crops and turf applications. These rates are expressed as: low, mid-range (med), and maximum (high). This translates to the highest application rate for various crops. Separate categories (such as mixing/loading WP for chemigation vs. groundboom) are presented because of the distinct differences in application rates and acres treated. More or less categories may be used to represent the handler exposure in the final version.

Application rates are generally in lbs ai/acre. However, exceptions exist, such as lbs ai/lbs seed treated. Low-pressure handwand application is expressed in lbs ai/thousands of square feet. High-pressure handwand application rates are in lbs ai/gallon. Likewise, the number of units treated will correspond, for example:

lbs ai/acre x acres/day = lbs ai/day

The number of treatments per year is also based on label information. However, the “private”, farmer, or golf-course grounds supervisor, may treat different areas or crops at different times. Generally, this column will be equal to the label maximum number of applications. Sometimes it is lower or higher based on use information. The “commercial” number of treatments is the estimated number of applications for a professional pesticide applicator not associated with a single location. The “default,” used in the absence of specific information, is 10 times the private applicator rate.

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole			
Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixer/Loader Descriptors			
Mixing/Loading Wettable Powder for Groundboom Application to Golf Course Turf (1a) or chemigation (1b)	PHED V1.1	(1a) 40 acres. (1b) 2 acres	**Single Layer, No Gloves:** Dermal replicates = 22-45, ABC grade. Hand replicates = 7, ABC grade. **Low Confidence** due to the low number of hand replicates; medium confidence in inhalation data. **Single Layer, Gloves:** "Best Available" grades: Inhalation ABC grades; 44 replicates; Hand replicates = 24, ABC grade. **Medium Confidence**. **Engineering Controls** (to represent water-soluble packets): "Best Available" grades: Hands acceptable grade; dermal and inhalation all grades. Hands = 5 replicates; dermal =6 to 15 replicates; inhalation = 15 replicates. Low confidence in hands, dermal and inhalation data. PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator.
Loading Granular for In-Furrow Application (2)	PHED v 1.1	80 acres / 230[U]	Single layer, no gloves: Dermal replicates = 33 - 78, ABC grade. Hand = 10 replicates, All grade. **Low Confidence** due to the poor grade quality of the hand replicates and low replicate number. Single Layer, gloves: Dermal replicates = 33 - 78, ABC grade. Hand = 45 replicates, AB grade. **Medium Confidence** Coveralls over single layer, plus gloves: Dermal replicates = 12 - 59, ABC grade. Hand = 45 replicates, AB grade. **Low Confidence** due to the low replicate number for many body parts. Inhalation: 58 replicates, AB grade. **High Confidence** Engineering Control: No data available.

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixing/Loading Liquid (EC/FC) for In-Furrow Application (3a: on-farm)	PHED v. 1.1	80 acres / 230[U]	Single layer, no gloves: Dermal = 72 to 122 replicates, AB grade. Hand = 53 replicates, AB grade. **High Confidence** Single layer, gloves: Dermal = 72 to 122 replicates, AB grade. Hand = 59 replicates, AB grade. **High Confidence** Inhalation: Replicates = 85, AB grade. **High Confidence**.
Mixing/Loading Liquid (EC/FC) for On-Farm Seed Treatment (3b)	PHED v. 1.1	1400 lbs cotton seed 7200 lbs peanut seed (for 80 A/day)	
Commercial Seed Treatment Loader/Applicator: Liquid Formulation (3c)	Uniroyal Data	330,000 lbs seed	See Study Review; based on geometric mean of data and "typical" volume of seed handled per day.
Commercial Seed Handler/Bagger: Liquid Formulation (3d)	Uniroyal Data	330,000 lbs seed	See Study Review; based on geometric mean of data and "typical" volume of seed handled per day.
Loading Dust for Commercial Seed Treatment (WP Surrogate) (4)	PHED v. 1.1	330,000 lbs seed	See Wettable Powder (1a); wettable powder has similar particulate size to dusts therefore used as a surrogate when there is a lack of data. PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator. No Data for Engineering Control

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole			
Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Applicator Descriptors			
Applying Liquid to Golf Course Turf with a Groundboom Sprayer (5a)	PHED V1.1	40 acres.	Single layer, no gloves: Dermal replicates = 23 to 42, AB grade. Hand replicates = 29, AB grade. The neck location is limited to 23 observations; the next lowest number of observations is 32. **High Confidence.** Single layer, gloves: Dermal replicates = 23 to 42, AB grade. Hand replicates = 21, ABC grade. The neck location is limited to 23 observations; the next lowest number of observations is 32. **Medium Confidence**. Inhalation: 22 replicates, AB grade. **High Confidence** Engineering Control: Enclosed cab (groundboom): Dermal replicates = 20 to 31, ABC grade. Hand replicates = 16, ABC grade. **Medium Confidence**; inhalation: 16 replicates, AB grade. **High Confidence**
Applying Liquid In-Furrow to Soil (5b)	PHED v. 1.1	80 / 230[U] acres	
Loading and Applying Granular In-Furrow to Soil (6)	PHED v. 1.1	80 / 230[U]	Single layer, no gloves: Dermal Replicates = 1 to 5, AB grade. Hand replicates = 5, AB grade. **Low Confidence** due to inadequate replicate number. Single layer, gloves: Dermal replicates = 1 to 5, AB grade. Hand replicates = 0. **Low Confidence** due to inadequate replicate number. **NOTE**: Gloved hand replicates are unavailable for this exposure scenario. The only way to estimate gloved hand exposure is to reduce the "no glove" hand value by 90%. Inhalation: 5 replicates, AB grade. **Low Confidence** due to the low replicate number.
Mixer/Loader/Applicator Descriptors			
Mixing, loading and Applying Liquid (EC/FC) In-Furrow (groundboom MLAP surrogate) (7)	PHED v. 1.1	80 / 160[U]	Single layer, no gloves: Dermal = 17 to 67, ABC grade. Hand = 29 replicates, ABC grade. **Medium Confidence** Single layer, gloves:Dermal = 17 to 67, ABC grade. Hand = 32 replicates, AB grade. **Medium Confidence**.

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole			
Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixing/Loading/Applying as a Seed Treatment (dry) in planter box (8a)	Fenske Study data	1440 lbs seed (study data and cotton data)	All data were for gloved hands; seed treatment only, not planting; 60 replicates (see study).
Treating Seed Manually Using Liquid (EC/FC) formulation on Farm (8b)	PHED v. 1.1 (surrogate)	1440 lbs seed (study data and cotton data)	No chemical-specific data: surrogate liquid mixer/loader (4a)
Mixing/Loading/Applying EC/FC as Liquid Drench using Low-pressure Hand Wand (9)	PHED v. 1.1	5000 sq. ft. - 0.5 acres	Single layer, no gloves: Dermal replicates = 9 to 80, ABC grade. Hand replicates = 70, All grade. **Low Confidence** due to inadequate replicate number and low hand grades used (lots of "E" grade.) Single layer, gloves: Dermal replicates = 9 to 80, ABC grade. Hand replicates =10, ABC grade**.** **Low Confidence** due to inadequate replicate number. The gloved hand estimates are based almost entirely on non-detects. Inhalation: 80 replicates, ABC grade. **Medium Confidence**. PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator Engineering controls not feasible.
Mixing/Loading/Applying EC/FC as Liquid Drench using High-pressure Hand Wand (10)	PHED v. 1.1	1000 gallons	Single layer, no gloves: Dermal replicates = 7 to 13, AB grade. Hand replicates = 0. "No glove" hand data are unavailable for this use scenario. (2 of 13 nondetect). **Low Confidence** Single layer, gloves: Dermal replicates = 7 to 13, AB grade. Hand replicates = 13, C grade. **Low Confidence** due to inadequate replicate number. Inhalation: 13 replicates, A grade. **Low Confidence** due to inadequate replicate number.
Loading and Applying Granular Formulation to Golf Course Turf Using a Belly Grinder (11)	PHED v. 1.1	1 acre	Single layer, no gloves:Dermal replicates = 29 to 45, ABC grade. Hand replicates = 23, ABC grade. **Medium Confidence**. Single layer: gloves: Dermal replicates = 29 to 45, ABC grade. Hand replicates = 20, All grades. **Low Confidence** Inhalation: 40 replicates, AB grade. **High Confidence** PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Loading and Applying Granular Formulation to Golf Course Turf Using Push-Type Spreader (12)	PHED v. 1.1	5 acres	Single layer, no gloves: Dermal replicates = 0 to 15, C grade. Hand replicates = 15, C grade. **Low Confidence** due to inadequate replicate number. There are no head or neck replicates for this clothing scenario. All other body parts contain 15 replicates. Single layer, gloves: Dermal replicates = 0 to 15, C grade. Hand replicates = 0. **Low Confidence** due to inadequate replicate number. There are no head, neck or hand replicates for this clothing scenario. All other body parts contain 15 replicates. Inhalation: 15 replicates, B grade. **High Confidence**.
Loading and Applying Granular Formulation to Golf Course Turf Using Tractor-drawn Spreader (13)	PHED v. 1.1	5 acres	Add scenarios (3) and (7)
Mixing, Loading, and Applying WP to Golf Course Turf with Ground Boom (14)	PHED v. 1.1	40 acres	Combine Scenarios (1a) and (6a) Engineering: WSB or enclosed-cab Groundboom (6b) PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator
Loading and Applying Granules to Potting Soil (15)	PHED v. 1.1	10 cubic yards	Use hand dispersing granules as surrogate (same as 25): Single layer, no glove: Dermal replicates = 16, ABC grade. Hand replicates = 0. **Low Confidence** due to lack of "no glove" replicates for this use scenario. Single layer, glove: Dermal replicates = 16, ABC grade. Hand replicates = 15, ABC grade. **Medium Confidence**. The 15 hand replicates are all nondetect (LOQ = 41 μg). Inhalation: 16 replicates, ABC grade. **Medium Confidence**. PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator

Table 1: Exposure Scenario Descriptions for the Use of Etridiazole			
Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Loading and Applying Wettable Powder to Potting Soil (16)	PHED v. 1.1	10 cubic yards	Use mixing/loading WP as surrogate (mixed dry): (1a)
Loading and Applying Granules to Soil using Belly Grinder (17,18)	PHED v. 1.1	1 acre	See Scenario 12 PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator
Loading and Applying Granules to Soil using Push-Type Spreader (19,20)	PHED v. 1.1	1 acre	See Scenario 13 PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator
Loading and Applying Granules to Soil using Tractor-Drawn Spreader(21,22)	PHED v. 1.1	5 acres	See Scenario 14 PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator
Loading/Applying Granular via Power Dust Blower (23)	NO DATA	NO DATA	NO DATA
Applying Granules by Hand to Soil Trench or Turf (24)	PHED v. 1.1	5000 sq. ft.	Single Layer, No Glove: Dermal replicates = 16, ABC grade. Hand replicates = 0. **Low Confidence** due to lack of "no glove" replicates for this use scenario. Single Layer, gloves: Dermal replicates = 16, ABC grade. Hand replicates = 15, ABC grade. **Medium Confidence**. Inhalation: 16 replicates, ABC grade. **Medium Confidence** PHED data used for baseline,50% Protection Factors (PFs) added for Coveralls; 90% Inhalation Protection Factor added for Organic Vapor/Pesticide Respirator

[a] Standard Assumptions based on an 8-hour work day as estimated by HED, or BEAD data, or Registrant data. The area treated per day also represents amount to be mixed up per day.

U Uniroyal estimated acreage/day

[b] "Best Available" grades are defined by HED SOP for meeting Subdivision U Guidelines. Best available grades are assigned as follows: matrices with grades A and B data and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality and number of replicates. Data confidence are assigned as follows:

High = grades A and B and 15 or more replicates per body part
Medium = grades A, B, and C and 15 or more replicates per body part
Low = grades A, B, C, D and E or any combination of grades with less than 15 replicates

Table 2: Worker Exposure Calculated from Uniroyal Study of Vitavax Application in Commercial Seed Treatment Using Terra-Coat L-205N Application Rates

Level of Protective Equipment	Handler Job Description	Dermal and Inhalation Total Unit Dosage (mg/lb ai)[a]	Lb Treated per Day[b]	Label Application Rate:Terra-Coat Liquid (lb ai/lb seed treated)	Total Dose (mg/kg/day)	IT MOE[d]	Work days/Year	LADD (mg/kg/day)	Cancer[f]
Single Layer with Gloves	Loader/Applicator	0.064	330000	0.00016	0.048	99	60	4.0E-03	1.3E-04
Single Layer with Gloves	Loader/Applicator	0.064	800000	0.00016	0.12	40	60	NA	NA
Single Layer with Gloves	Seed Handler	0.0024	330000	0.00016	0.0018	2500	60	1.5E-04	5.0E-06
Single Layer with Gloves	Seed Handler	0.0024	800000	0.00016	0.0044	1000	60	NA	NA
Single Layer No Gloves (calculated)	Loader/Applicator	0.356	330000	0.00016	0.27	18	60	2.2E-02	7.3E-04
Single Layer No Gloves (calculated)	Loader/Applicator	0.356	800000	0.00016	0.65	6.9	60	NA	NA
Single Layer No Gloves (calculated)	Seed Handler	0.015	330000	0.00016	0.011	420	60	9.3E-04	3.1E-05
Single Layer No Gloves (calculated)	Seed Handler	0.015	800000	0.00016	0.027	160	60	NA	NA

IT = Intermediate-Term

NA = Not applicable to this scenario: cancer risks are based on "typical" application rates and volumes, not the higher rate.

[a]Total (Dermal + Inhalation) Unit Dose was calculated from Vitavax study for lindane residues MRID 447315-01; inhalation dose less than 1% of total.

[b] Pounds treated per day based on study findings and equipment manufacturer's specifications; typical and high capacity used.

[c]Total (Dermal + Inhalation) Daily Dose (mg ai/kg/day) = (mg/lb ai) x lb treated/day * application rate (mg/lb seed) / Body weight (70kg for intermediate-term) x Absorption (100%)

[d]MOE = NOAEL (mg/kg/day) / Daily Dose (mg/kg/day); where intermediate-term NOAEL = 4.8 mg/kg/day

[e]LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr * 35 years working}}{\text{70 years (lifetime) x 365 days/yr}}$

[f]Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]

Table 3: MOE and Cancer Risk Estimate for On-Farm Dust Formulation Seed Treatment
Based on Data from Fenske et al. Study; Mixer/Loader, Single Layer PPE With Gloves

Formulation	Dermal Unit Dosage (mg/lb ai)[a]	Inhalation Unit Dose (mg/lb ai)[a]	Typical Lb Treated per Day[b]	Application Rate (lb ai/lb seed) Cotton	Dermal Dose (mg/day)	Inhalation Dose (mg/day)	Total Dose (mg/day)[c]	ST MOE[d]	IT/LT MOE[e]	LADD (mg/kg/day)[f]	Cancer[g]
Terraclor Super X 20-5	10.4	0.0024	1440	0.0005	7.5	0.0017	7.5	130	45	8.9E-03	3.0E-04

Mixer/Loader Only. No Application Data.
Formulation adjusted for Terraclor Super X 20-5 (dust formulation) application rate.
Study findings adjusted for body surface areas per Exposure Factors Handbook 1997 and standard respiratory rate for handlers of 29 l/min.
IT = Intermediate-Term duration; ST = Short-term duration
Cancer risks are based on "typical" application rates and volumes

[a] Unit Doses (dermal and inhalation) were calculated from published study (see References) measuring lindane residues; note inhalation dose less than 1% of total.

[b] Pounds treated per day based on study findings and equipment and Registrant-submitted data for cotton seed application.

[c] Total (Dermal + Inhalation) Daily Dose (mg ai/kg/day) = (mg/lb ai) x lb treated/day * application rate (mg/lb seed) / Body weight (70kg for intermediate-term) x Absorption (100%)

[d] ST = Short-term MOE = NOAEL (mg/kg/day) / Daily Dose (mg/kg/day); where short-term NOAEL = 15 mg/kg/day; 60 kg b.w.

[e] MOE = NOAEL (mg/kg/day) / Daily Dose (mg/kg/day); where intermediate-term NOAEL = 4.8 mg/kg/day; 70 kg b.w.

[f] LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr [60 days/yr] * 35 years working}}{\text{70 years (lifetime) x 365 days/yr}}$

[g] Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]

Table 4: Etridiazole Handler Risk Assessment: Short-term MOEs

	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls over Clothing and Organic Vapor Respirator			Engineering Controls: Soluble Bag for WP; Gloves for M/L Only		
Exposure Scenario	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE
(1a) Mixing/Loading Wettable Powder for Turf/Golf Course Groundboom Application: Low Rate	3.2	280	3.2	70	280	56	90	2800	87	1200	4.9E+04	1200
(1a) Typical Rate	1.6	140	1.6	35	140	28	45	1400	43	600	2.5E+04	590
(1a) High Rate	0.80	69	0.79	17	69	14	22	690	22	300	1.2E+04	290
(1b) Mixing/Loading Wettable Powder for Chemigation Application (lb/1000 Gal):Low Rate	320	2.7E+04	310	6600	2.7E+04	5300	NE	NE	NE	NE	NE	NE
(1b) Typical Rate	160	1.4E+04	160	3500	1.4E+04	2800	NE	NE	NE	NE	NE	NE
(1b) High Rate	110	9500	110	2400	9500	1900	NE	NE	NE	NE	NE	NE
(2) Loading Granular for in-Furrow Application: UniRoyal Estimated Rate	2300	1.2E+04	1900	4700	1.9E+04	3800	NE	NE	NE	NE	NE	NE
(2) Typical Rate	5600	2.8E+04	4600	6.8E+03	2.8E+04	5500	NE	NE	NE	NE	NE	NE
(2) High Rate	3500	1.7E+04	2900	4.3E+03	1.7E+04	3400	NE	NE	NE	NE	NE	NE
(3a) Mixing/Loading EC/FC (Liquid) for In-furrow Application: Low Rate	11	2.6E+04	11	1400	2.6E+04	1300	NE	NE	NE	NE	NE	NE
(3a) Typical Rate	20	4.9E+04	20	2.6E+03	4.9E+04	2400	NE	NE	NE	NE	NE	NE
(3a) High Rate	10	2.5E+04	10	1.3E+03	2.5E+04	1200	NE	NE	NE	NENE	NE	NE
(3b) Mixing/Loading Liquid for On-Farm Seed Treatment: Low (Peanuts)	550	1.3E+06	550	7.0E+04	1.3E+06	6.6E+04	NE	NE	NE	NE	NE	NE
(3b) Typical (Peanuts)	280	6.7E+05	280	3.5E+04	6.7E+05	3.3E+04	NE	NE	NE	NE	NE	NE
(3b) High (Cotton)	350	8.3E+05	350	4.4E+04	8.3E+05	4.1E+04	NE	NE	NE	NE	NE	NE
(3c) Loader/Applicator: EC/FC Liquid for Commercial Seed Treatment: Typical Rates (Uniroyal Study)	49	1.2E+04	48	280	1.2E+04	270	NE	NE	NE	NE	NE	NE
(3c) High Volume	20	5100	20	110	5.2E+03	110	NE	NE	NE	NE	NE	NE
(3d) Seed Handler/bagger: Liquid for Commercial Seed Treatment: Typical Rates (Uniroyal Study)	1200	9.7E+04	1200	7900	9.7E+04	7300	NE	NE	NE	NE	NE	NE

Table 4: Etridiazole Handler Risk Assessment: Short-term MOEs

	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls over Clothing and Organic Vapor Respirator			Engineering Controls: Soluble Bag for WP; Gloves for M/L Only		
Exposure Scenario	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE
(3d) High Volume	480	4.0E+04	480	3300	4.0E+04	3000	NE	NE	NE	NE	NE	NE
(4) Loading Dust for Commercial Seed Treatment: (WP surrogate) Low Rate	12	1000	12	260	1000	200	330	NE	NE	NE	NE	NE
(4) Typical Rate	5.9	510	5.8	130	510	100	170	5.1E+03	160	NE	NE	NE
(4) High Rate	0.61	52	0.60	32	130	26	41	1300	40	560	2.3E+04	540
(5a) Applying to Turf/Golf Course with Groundboom Sprayer: Low Rate	680	1.3E+04	800	850	1.6E+04	800	NE	NE	NE	NE	NE	NE
(5a) Typical Rate	420	8000	400	420	8.0E+03	400	NE	NE	NE	NE	NE	NE
(5a) High Rate	210	4000	200	210	4.0E+03	200	NE	NE	NE	NE	NE	NE
(5b) Applying Liquid In-furrow (Groundboom Surrogate): Low Rate	2200	4.1E+04	2100	2200	4.1E+04	2100	NE	NE	NE	NE	NE	NE
(5b) Typical Rate	4200	8.0E+04	4000	4.2E+03	8.0E+04	4000	NE	NE	NE	NE	NE	NE
(5b) High Rate	2100	4.0E+04	2000	2.1E+03	4.0E+04	2100	NE	NE	NE	NE	NE	NE
(6) Combined Loading + Applying Granules In-Furrow to Soil: Low Rate	1100	6700	920	2200	6700	1700	NE	NE	NE	NE	NE	NE
(6) Typical Rate	2000	1.3E+04	1800	4.3E+03	1.3E+04	3200	NE	NE	NE	NE	NE	NE
(6) High Rate	1600	1.0E+04	1400	3.4E+03	1.0E+04	2600	NE	NE	NE	NE	NE	NE
(7) M/L/Applying EC/FC In-Furrow to Soil: Low Rate	120	3.4E+04	120	2100	2.3E+04	1900	NE	NE	NE	NE	NE	NE
(7) Typical Rate	160	4.6E+04	160	2.8E+03	3.1E+04	2600	NE	NE	NE	NE	NE	NE
(7) High Rate	80	2.3E+04	80	1.4E+03	1.5E+04	1300	NE	NE	NE	NE	NE	NE
(8) Mixing/Loading/ Applying as a Seed Treatment (dry) in planter box [Fenske study data] (per lb seed)	NO UN-GLOVED DATA	5.2E+05	NO DATA	120	5.2E+05	120	NE	NE	NE	NE	NE	NE
(9) Mixing/Loading/ Applying EC/FC as Drench using Low Pressure Handwand: Typical (per Gallon diluted mixture)	140	4.8E+05	140	3.3E+04	4.8E+05	3.1E+04	NE	NE	NE	NE	NE	NE

Table 4: Etridiazole Handler Risk Assessment: Short-term MOEs

	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls over Clothing and Organic Vapor Respirator			Engineering Controls: Soluble Bag for WP; Gloves for M/L Only		
Exposure Scenario	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE
(10) Mixing/Loading/ Applying EC/FC using High Pressure Handwand (ie, Nursery/Greenhouse): High Rate	330	6700	320	320	6.7E+03	310	NE	NE	NE	NE	NE	NE
(11) Loading+Applying Granules (1.3G) to Golf Course Turf using Belly Grinder: Typical Rate/Acre	20	3200	20	22	3.2E+03	21	35	3200	35	No Data	No Data	No Data
(12) Loading+Applying Granules (1.3G) to Golf Course Turf Using Push Type Spreader: Typical rate/Acre	14	6300	14	31	6.3E+03	31	53	6.3E+04	53	No Data	No Data	No Data
(13) Loading+Applying Granules (1.3G) to Golf Course Turf Using Tractor-pulled Spreader: (2 scenarios added) Typical Rate	4600	1.4E+04	3400	4.6E+03	1.4E+04	3500	NE	NE	NE	NE	NE	NE
(14) Combined Mixing/Loading +Applying WP to Golf Course Turf via Groundboom (2 scenarios added): Low Rate	3.2	270	3	53	220	42	66	2100	64	630	1.4E+04	600
(14) Typical Rate	1.6	140	2	33	140	27	41	1300	40	400	8.8E+03	380
(14) High Rate	0.80	68	0.8	16	68	13	21	670	20	200	4.4E+03	190
(15) Mixing/Loading Applying Granules to Potting Soil (per CU yd)	3.4E+05	1.7E+06	2.9E+05	4.2E+05	1.7E+06	3.3E+05	NE	NE	NE	No Data	No Data	No Data
(16) Mixing/Loading/ Applying WP to Potting Soil (per Cu Yd)	370	3.2E+04	370	7.62E+03	3.12E+04	6100	NE	NE	NE	NE	NE	NE
(17) Loading+Applying Granules (8G) to Soil using Belly Grinder: Typical Rate/Acre	5.80	930	5.7	6	930	6	10	930	9	No Data	No Data	No Data

Table 4: Etridiazole Handler Risk Assessment: Short-term MOEs

	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls over Clothing and Organic Vapor Respirator			Engineering Controls: Soluble Bag for WP; Gloves for M/L Only		
Exposure Scenario	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE	Dermal ST MOE	Inhalation ST MOE	Combined ST Dermal & Inhalation MOE
(18) Loading+Applying Granules (5G) to Soil using Belly Grinder: Typical Rate/Acre	5.1	830	5.1	6	830	5.5	9	830	14	No Data	No Data	No Data
(19) Loading+Applying Granules (5G) to Soil Using Push Type Spreader: Typical rate/Acre	3.6	1600	3.5	8	1600	7.9	14	1.6E+04	15	No Data	No Data	No Data
(20) Loading+Applying Granules (8G) to Soil Using Push Type Spreader: Typical rate/Acre	4.0	1800	4.0	9	1800	8.8	15	1.8E+04	15	No Data	No Data	No Data
(21) Loading+Applying Granules (8G) to Soil Using Tractor-pulled Spreader: (2 scenarios added) Typical rate/ Acre	1300	4000	1000	1300	4000	1000	NE	NE	NE	No Data	No Data	No Data
(22) Loading+Applying Granules (5G) to Soil Using Tractor-pulled Spreader: (2 scenarios added) Typical rate/ Acre	150	440	110	150	440	110	NE	NE	NE	No Data	No Data	No Data
(23) Loading/Applying Granular via Power Dust Blower	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(24) Dispersing Granules By Hand	4.9	1100	4.9	7.4	1100	7.3	13	1.1E+04	13	No Data	No Data	No Data

Note: table values were calculated using a spreadsheet and then rounded to two significant figures.
ST = Short Term (generally seven days or less)
'No Data' indicates data not available for that scenario.
"NE" = scenario not evaluated.
Equations used in this table include:

Daily dermal exposure (mg ai/day) = Unit exposure (mg ai/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)
[Note: (lb ai/acre) and (A/day) are replaced, respectively, with (lb ai/gal) and (gal/day), or lb ai/lb seed when appropriate.]

Daily exposure (mg ai/day) = [Unit exposure (μg/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)] / (1000 μg/mg)
Potential absorbed daily dermal or inhalation dose = (mg ai/kg/day) x Absorption (100%) / Body weight
Body weight = short-term 60 kg; intermediate-term 70 kg
MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)
$MOE_{Combined} = 1 / (1/MOE_{dermal} + 1/MOE_{inhalation})$

Table 5: Etridiazole Handler Risk Assessment: Intermediate-term MOEs												
	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls Over Single Layer Clothing With Gloves and OV Respirator			Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only		
Exposure Scenario	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT /LT Dermal & Inhalation MOE
(1a) Mixing/Loading Wettable Powder for Turf/Golf Course Groundboom Application: Low Rate	1.2	100	1.2	26	100	21	33	1000	32	450	1.8E+04	440
(1a) Typical Rate	0.60	51	0.59	13	51	10	17	510	16	230	9.2E+03	220
(1a) High Rate	0.30	26	0.29	6	26	5	8	260	8	110	4.6E+03	110
(1b) Mixing/Loading Wettable Powder for Chemigation Application (lb/1000 Gal):Low Rate	120	1.0E+04	120	2600	1.0E+04	2000	NE	NE	NE	NE	NE	NE
(1b) Typical	61	5200	60	1300	5200	1100	NE	NE	NE	NE	NE	NE
(1b) High	41	3600	41	900	3600	720	NE	NE	NE	NE	NE	NE
(2) Loading Granular for in-Furrow Application: UniRoyal Estimated Rate	870	4300	720	1800	7200	1400	NE	NE	NE	NE	NE	NE
(2) Typical Rate	2100	1.0E+04	1700	2.5E+03	1.0E+04	2000	NE	NE	NE	NE	NE	NE
(2) High Rate	1300	6500	1100	1600	6500	1300	NE	NE	NE	NE	NE	NE
(3a) Mixing/Loading EC/FC (Liquid) for In-furrow Application: Low (Uniroyal Rate)	4	9700	4	510	9700	480	NE	NE	NE	NE	NE	NE
(3a) Typical Rate	8	1.8E+04	8	9.6E+02	1.8E+04	910	NE	NE	NE	NE	NE	NE
(3a) High Rate	4	9200	4	4.8E+02	9200	460	NE	NE	NE	NE	NE	NE
(3b) Mixing/Loading EC/FC for On-Farm Seed Treatment: Low Rate (Peanuts)	210	5.0E+05	210	2.6E+04	5.0E+05	2.5E+04	NE	NE	NE	NE	NE	NE
(3b) Typical (Peanuts)	100	2.5E+05	100	1.3E+04	2.5E+05	1.2E+04	NE	NE	NE	NE	NE	NE
(3b) High (Cotton)	130	3.1E+05	130	1.6E+04	3.1E+05	1.5E+04	NE	NE	NE	NE	NE	NE
(3c) Loader/Applicator: EC/FC for Commercial Seed Treatment: Typical Rate (Uniroyal Study)	18	4.7E+03	18	100	4.7E+03	100	NE	NE	NE	NE	NE	NE

Table 5: Etridiazole Handler Risk Assessment: Intermediate-term MOEs												
	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls Over Single Layer Clothing With Gloves and OV Respirator			Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only		
Exposure Scenario	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT /LT Dermal & Inhalation MOE
(3c) Loader/Applicator: Liquid for Commercial Seed Treatment: High Volume (Uniroyal Study)	7	1.9E+03	7	43	1.9E+03	42	No Data	No Data	No Data	No Data	No Data	No Data
(3d) Seed Handler/bagger: Liquid for Commercial Seed Treatment: Typical Rates (Uniroyal Study)	440	3.6E+04	430	3000	3.6E+04	2700	NE	NE	NE	NE	NE	NE
(3d) High Volume (Uniroyal Study)	180	1.5E+04	180	1224	1.5E+04	1100	NE	NE	NE	NE	NE	NE
(4) Loading Dust for Commercial Seed Treatment: Low (WP surrogate)	4.4	380	4	96	379	76	120	3.8E+03	120	1700	6.8E+04	1600
(4) Typical (WP surrogate)	2.2	190	2	48	190	38	62	1.9E+03	60	830	3.4E+04	800
(4) High (WP surrogate)	0.23	20	0.22	12	47	10	15	470	15	210	8.5E+03	200
(5a) Applying to Turf/Golf Course with Groundboom Sprayer: Low Rate	250	4.8E+03	240	320	6.0E+03	300	NE	NE	NE	NE	NE	NE
(5a) Typical Rate	160	3.0E+03	150	160	3.0E+03	150	NE	NE	NE	NE	NE	NE
(5a) High	79	1.5E+03	75	79	1.5E+03	75	100	1.5E+04	100	NE	NE	NE
(5b) Applying Liquid In-furrow: Low (Uniroyal Rate)	820	1.5E+04	770	820	1.5E+04	770	NE	NE	NE	NE	NE	NE
(5b) Typical Rate	1.6E+03	3.0E+04	1.5E+03	1600	3.0E+04	1500	NE	NE	NE	NE	NE	NE
(5b) High	790	1.5E+04	750	790	1.5E+04	750	NE	NE	NE	NE	NE	NE
(6) Combined Loader+Applicator Granules In-Furrow to Soil (Low) Uniroyal rate	400	2500	340	840	2500	630	NE	NE	NE	NE	NE	NE
(6) Typical Rate	770	4.8E+03	660	1.6E+03	4.8E+03	1210	NE	NE	NE	NE	NE	NE
(6) High Rate	600	3.8E+03	520	1.3E+03	3.8E+03	950	NE	NE	NE	NE	NE	NE

Table 5: Etridiazole Handler Risk Assessment: Intermediate-term MOEs												
	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls Over Single Layer Clothing With Gloves and OV Respirator			Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only		
Exposure Scenario	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT /LT Dermal & Inhalation MOE
(7) Combined Loader+Applicator EC/FC In-Furrow to Soil (Uniroyal Rate)	44	1.3E+04	44	780	8500	720	NE	NE	NE	NE	NE	NE
(7) Typical Rate	60	1.7E+04	60	1.1E+03	1.1E+04	960	NE	NE	NE	NE	NE	NE
(7) High Rate	30	8.5E+03	30	526	5.7E+03	480	NE	NE	NE	NE	NE	NE
(8) Mixing/Loading/ Applying as a Seed Treatment (dry) in planter box [Fenske study data] (per lb seed)	No Data	1.9E+05	No Data	45	1.9E+05	45	No Data	No Data	No Data	No Data	No Data	No Data
(9) Mixing/Loading/ Applying EC/FC as Drench using Low pressure Handwand: Typical (per Gallon diluted mixture)	53	1.8E+05	53	1.3E+04	1.8E+05	1.2E+04	NE	NE	NE	No Data	No Data	No Data
(10) Mixing/Loading/ Applying EC/FC using High Pressure Handwand (ie, Nursery/Greenhouse): High	120	2.5E+03	120	120	2.5E+03	120	NE	NE	NE	No Data	No Data	No Data
(11) Loading+Applying Granules (1.3G) to Golf Course Turf using Belly Grinder: Typical Rate/Acre	7.5	1.2E+03	7	8	1.2E+03	8	13	1200	13	No Data	No Data	No Data
(12) Loading+Applying Granules (1.3G) to Golf Course Turf Using Push Type Spreader: Typical rate/Acre	5.1	2.4E+03	5	11	2.4E+03	11	20	2.4E+04	20	No Data	No Data	No Data
(13) Loading+Applying Granules (1.3G) to Golf Course Turf Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	1700	5.1E+03	1300	1.7E+03	5.1E+03	1300	NE	NE	NE	NE	NE	NE

Table 5: Etridiazole Handler Risk Assessment: Intermediate-term MOEs												
	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls Over Single Layer Clothing With Gloves and OV Respirator			Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only		
Exposure Scenario	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT /LT Dermal & Inhalation MOE
(14) Combined M/L/App WP to Golf Course Turf via Groundboom (2 scenarios added): Low	1.2	100	1	20	81	16	25	800	24	240	5.3E+03	230
(14) Typical Rate	0.60	51	0.60	12	51	10	15	500	15	150	3.3E+03	140
(14) High Rate	0.30	25	0.29	6	25	5	8	250	7	74	1.6E+03	71
(15) Mixing/Loading Applying Granules to Potting Soil (per CU yd)	1.3E+05	6.3E+05	1.1E+05	1.6E+05	6.3E+05	1.3E+05	NE	NE	NE	No Data	No Data	No Data
(16) Mixing/Loading/ Applying WP to Potting Soil (per Cu Yd)	140	1.2E+04	140	2900	1.2E+04	2300	No Data	No Data	No Data	No Data	No Data	No Data
(17) Loading+Applying Granules (8G) to Soil using Belly Grinder: Typical Rate/Acre	2.2	350	2	2	350	2	4	350	4	No Data	No Data	No Data
(18) Loading+Applying Granules (5G) to Soil using Belly Grinder: Typical Rate/Acre	1.9	310	2	2	310	2	3	310	3	No Data	No Data	No Data
(19) Loading+Applying Granules (5G) to Soil Using Push Type Spreader: Typical rate/Acre	1.3	610	11	3	610	3	5	6100	5	No Data	No Data	No Data
(20) Loading+Applying Granules (8G) to Soil Using Push Type Spreader: Typical rate/Acre	1.5	680	1.5	3	680	3	6	6800	6	No Data	No Data	No Data
(21) Loading+Applying Granules (8G) to Soil Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	500	1500	370	500	1500	370	NE	NE	NE	NE	NE	NE

Table 5: Etridiazole Handler Risk Assessment: Intermediate-term MOEs												
	Baseline (Single Layer Clothing)			Single Layer Clothing With Chemical Resistant Gloves			Coveralls Over Single Layer Clothing With Gloves and OV Respirator			Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only		
Exposure Scenario	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT Dermal & Inhalation MOE	Dermal IT MOE	Inhalation IT MOE	Combined IT /LT Dermal & Inhalation MOE
(22) Loading+Applying Granules (5G) to Soil Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	55	170	41	55	170	41	61	1700	59	No Data	No Data	No Data
(23) Loading/Applying Granular via Power Dust Blower	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(24) Dispersing Granules By Hand	1.8	420	2	2.8	420	3	4.9	4200	4.9	No Data	No Data	No Data

Note: table values were calculated using a spreadsheet and then rounded to two significant figures.
IT = Intermediate Term, generally one week to several months duration.
"No Data" indicates data not available for that scenario.
"NE" indicates scenario not evaluated.
Equations used in this table include:

Daily dermal exposure (mg ai/day) = Unit exposure (mg ai/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)
[Note: (lb ai/acre) and (A/day) are replaced, respectively, with (lb ai/gal) and (gal/day), or lb ai/lb seed when appropriate.]

Daily exposure (mg ai/day) = [Unit exposure (μg/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)] / (1000 μg/mg)
Potential absorbed daily dermal or inhalation dose = (mg ai/kg/day) x Absorption (100%) / Body weight
Body weight = short-term 60 kg; intermediate-term 70 kg
MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)
$MOE_{Combined} = 1 / (1/MOE_{dermal} + 1/MOE_{inhalation})$

Table 6: Etridiazole Handler: Cancer Risk Estimates										
Exposure Scenario	Private Applications Per Year	Commercial Applications Per Year	Baseline (Single Layer Clothing without Gloves)		Single Layer Clothing With Chemical Resistant Gloves		Coveralls Over Single Layer Clothing With Gloves and OV Respirator		Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only	
			(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	Single Layer with Gloves (Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk
(1a) Mixing/Loading Wettable Powder for Turf/Golf Course Groundboom Application:Typical	5	15	1.9E-03	5.6E-03	1.1E-04	3.2E-04	6.8E-05	2.0E-04	5.0E-06	1.5E-05
(1b) Mixing/Loading Wettable Powder for Chemigation Application (lb/1000 Gal):Typical	3	30	1.1E-05	1.1E-04	6.2E-07	6.2E-06	4.0E-07	4.0E-06	2.9E-08	2.9E-07
(2) Loading Granular for in-Furrow Application: UniRoyal Estimated Rate	1	5	3.0E-07	1.5E-06	1.5E-07	1.1E-06	NE	NE	NE	NE
(2) Loading Granular for In -furrow Application: Typical	3	12	3.8E-07	1.5E-06	3.2E-07	1.3E-06	NE	NE	NE	NE
(3a) Mixing/Loading EC (Liquid) for In-furrow Application: Low (Uniroyal rate)	1	5	5.4E-05	2.7E-04	4.5E-07	2.3E-06	3.2E-07	1.6E-06	1.6E-07	8.1E-07
(3a) Mixing/Loading EC/FC (Liquid) for In-furrow Application: Typical	3	12	8.6E-05	3.4E-04	7.2E-07	2.9E-06	5.1E-07	2.0E-06	2.6E-07	2.6E-06
(3b) Mixing/Loading EC/FC for On-Farm Seed Treatment: Typical (Peanuts)	3	12	6.4E-06	2.5E-05	1.2E-07	3.5E-07	NE	NE	NE	NE
(3c) Loader/Applicator: EC/FC (Liquid) for Commercial Seed Treatment: Typical Rates (Uniroyal Study)	20	60	2.4E-04	7.3E-04	4.3E-05	1.3E-04	No Data	No Data	No Data	No Data
(3d) Seed Handler/bagger: Liquid for Commercial Seed Treatment: Typical Rates (Uniroyal Study)	20	60	1.0E-05	3.1E-05	1.6E-06	4.8E-06	No Data	No Data	No Data	No Data
(4) Loading Dust for Commercial Seed Treatment: Typical (WP surrogate)	20	60	2.0E-03	6.0E-03	1.1E-04	3.4E-04	7.3E-05	2.2E-04	5.4E-06	1.6E-05
(5a) Applying to Turf/Golf Course with Groundboom: typical	5	15	7.3E-06	2.2E-05	7.3E-06	2.2E-05	5.5E-06	1.6E-05	2.5E-06	7.6E-06
(5b) Applying Liquid In-furrow: low (Uniroyal rate)	1	7	2.8E-07	2.0E-06	2.8E-07	1.4E-06	NE	NE	NE	NE
(5b) Applying Liquid In-furrow: (typical rate)	3	12	4.4E-07	1.8E-06	4.4E-07	1.8E-06	NE	NE	NE	NE

Table 6: Etridiazole Handler: Cancer Risk Estimates										
Exposure Scenario	Private Applications Per Year	Commercial Applications Per Year	Baseline (Single Layer Clothing without Gloves)		Single Layer Clothing With Chemical Resistant Gloves		Coveralls Over Single Layer Clothing With Gloves and OV Respirator		Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only	
			(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	Single Layer with Gloves (Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk
(6) Combined Loader + Applicator Granules In-Furrow to Soil (Low) Uniroyal Rate	1	5	6.4E-07	3.2E-06	3.5E-07	1.7E-06	NE	NE	NE	NE
(6) Combined Loader + Applicator Granules In-Furrow to Soil (typical)	3	12	9.9E-07	4.0E-06	5.4E-07	2.2E-06	NE	NE	NE	NE
(7) Mixer/Loader/ Applying EC/FC In-Furrow to Soil (Uniroyal rate)	1	7	5.0E-06	3.5E-05	3.1E-07	2.1E-06	NE	NE	NE	NE
(7) Mixing/Loading/ Applying EC/FC In-Furrow to Soil (typical rate)	3	12	1.1E-05	4.4E-05	6.8E-07	2.7E-06	NE	NE	NE	NE
(8) Mixing/Loading/Applying as a Seed Treatment (dry) in planter box [Fenske study data] (per lb seed)	7	21	No Data	No Data	3.4E-06	1.0E-04	No Data	No Data	No data	No Data
(9) Mixing/Loading/Applying EC/FC as Drench using Low pressure Handwand: Typical (per Gallon diluted mixture)	3	30	1.2E-05	1.2E-04	5.6E-08	5.6E-07	NE	NE	NE	NE
(10) Mixing/Loading/Applying EC/FC using High Pressure Handwand (ie, Nursery/Greenhouse): High	3	30	5.5E-06	5.5E-05	5.8E-06	5.8E-05	3.5E-06	3.5E-05	No Data	No Data
(11) Loading+Applying Granules (1.3G) to Golf Course Turf using Belly Grinder: Typical Rate/Acre	4	12	1.2E-04	3.5E-04	1.1E-04	3.3E-04	1.7E-05	1.7E-04	No Data	No Data
(12) Loading+Applying Granules (1.3G) to Golf Course Turf Using Push Type Spreader: Typical rate/Acre	4	12	1.7E-04	5.1E-04	7.7E-05	2.3E-04	1.1E-05	1.1E-04	No Data	No Data
(13) Loading+Applying Granules (1.3G) to Golf Course Turf Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	4	12	6.8E-07	2.0E-06	6.8E-07	2.0E-06	4.6E-07	1.4E-06	NE	NE
(14) Combined Mixing/Loading/ Applying WP to Golf Course Turf via Groundboom (typical rate)	5	15	1.9E-03	5.6E-03	1.1E-04	3.3E-04	7.3E-05	1.5E-04	7.8E-06	1.6E-05
(15) Loading + Applying Granules to Potting Soil (per CU yd)	3	9	6.2E-09	1.9E-08	5.3E-09	1.6E-08	NE	NE	NE	NE
(16) Mixing/Loading/Applying WP to Potting Soil (per Cu Yd)	3	9	4.8E-06	1.4E-05	2.9E-07	8.6E-07	NE	NE	NE	NE

Table 6: Etridiazole Handler: Cancer Risk Estimates										
Exposure Scenario	Private Applications Per Year	Commercial Applications Per Year	Baseline (Single Layer Clothing without Gloves)		Single Layer Clothing With Chemical Resistant Gloves		Coveralls Over Single Layer Clothing With Gloves and OV Respirator		Engineering Controls: Closed System or Soluble Bag (for WP); Gloves for M/L Only	
			(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	Single Layer with Gloves (Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk	(Private) Cancer Risk	(Commercial) Cancer Risk
(17) Loading+Applying Granules (8G) to Soil using Belly Grinder: Typical Rate/Acre	3	9	3.1E-04	9.2E-04	2.9E-04	8.6E-04	1.8E-04	5.3E-04	No Data	No Data
(18) Loading+Applying Granules (5G) to Soil using Belly Grinder: Typical Rate/Acre	3	9	3.4E-04	1.0E-03	3.2E-04	9.6E-04	2.0E-04	5.9E-04	No Data	No Data
(19) Loading+Applying Granules (5G) to Soil Using Push Type Spreader: Typical rate/Acre	3	9	5.0E-04	1.5E-03	2.2E-04	6.7E-04	1.3E-04	3.9E-04	No Data	No Data
(20) Loading+Applying Granules (8G) to Soil Using Push Type Spreader: Typical rate/Acre	3	9	4.4E-04	1.3E-03	2.0E-04	6.0E-04	1.1E-04	3.4E-04	No Data	No Data
(21) Loading+Applying Granules (8G) to Soil Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	3	9	1.8E-06	5.3E-06	1.8E-06	5.3E-06	1.2E-06	3.7E-06	No Data	No Data
(22) Loading+Applying Granules (5G) to Soil Using Tractor-pulled Spreader: Typical rate/ Acre (2 scenarios added)	3	9	1.6E-05	4.8E-05	1.6E-05	4.8E-05	1.1E-05	3.4E-05	No Data	No Data
(23) Loading/Applying Granular via Power Dust Blower	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
(24) Dispersing Granules By Hand, based on SOP	3	9	3.6E-04	1.1E-03	2.4E-04	7.2E-04	2.5E-05	7.4E-05	NA	NA

Note: table values were calculated using a spreadsheet and then rounded to two significant figures.
"No Data" indicates data or control method not available for that scenario.
NE = Scenario not evaluated; NA = not applicable to this scenario
Equations used in this table include:

Daily dermal exposure (mg ai/day) = Unit exposure (mg ai/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)
[Note: (lb ai/acre) and (A/day) are replaced, respectively, with (lb ai/gal) and (gal/day), or lb ai/lb seed when appropriate.]

Daily exposure (mg ai/day) = [Unit exposure (μg/lb ai) x Application Rate (lb ai/A) x Daily Treatment (A/day)] / (1000 μg/mg)
Potential absorbed daily dermal or inhalation dose = (mg ai/kg/day) x Absorption (100%) / Body weight
Body weight = short-term 60 kg; intermediate-term 70 kg
MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)
$MOE_{ST,Combined} = 1 / (1/MOE_{ST,dermal} + 1/MOE_{ST,inhalation})$
Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]
LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr * 35 years working}}{\text{70 years (lifetime) x 365 days/yr}}$

Table 7: Occupational Post-Application Exposure Risks:
Terrazole Turf Residues: Post Application Day 0 (12 Hour Post-Application Study Data):
MOEs and Cancer Risk

Person/Activity	Study Residue (μg/cm2)	Transfer Factor = cm^2/hr	Dose mg/kg/day (Study Data)	ST MOE	IT MOE	Activity (Days/ Year)	IT LADD (mg/kg/day)	Cancer Risk (Study)
Occupational Exposures								
Tractor-Mowing[a]	0.13	500	3.7E-03	3500	1300	120	6.1E-04	2.0E-05
Push-Mowing	0.13	1000	7.4E-03	1700	650	120	1.2E-03	4.0E-05
Potting/handling treated soil[b]	0.37[c]	NA	5.3E-3	2400	900	120	8.7E-04	2.9E-05

[a] Turf transferable residues study: EPA MRID 432878-02.
[b] Potting soil study: EPA MRID 442787-01.
[c] Soil residue = total dose as mg / 4 hr day from study; there is no appropriate transfer factor
Turf transferable residues study: EPA MRID 432878-02.
ST = Short-term exposure duration seven days or less
IT = Intermediate Term exposure duration, generally one week to several months.
[Calculations performed on a spreadsheet before rounding to two places; therefore there may appear to be errors due to rounding]
Dermal dose (mg ai/kg/day) = (TTR(t) [$\mu g/cm^2$] x Tc (cm^2/hr) x DA x 0.001 mg/μg conversion x # hours (4) worked(or played)/day) / body weight (70 kg)
"NA" indicates data not applicable for that scenario.
MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)
LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr * 35 years working}}{\text{70 years (lifetime) x 365 days/yr}}$
Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]

Table 8: Post-application Handling of Seed Treated with Terrazole For Planting Cotton
Single Layer No Gloves Scenario

Formulation	Mixer/Loader + Applicator Unit Exposure: (mg/lb ai handled)		Application Rate (lb ai/100 lb cotton seed)	Dermal Dose (mg ai/day)	Inhalation Dose (mg ai/day)	MOE: Total Dose: Dermal + Inhalation		LADD:		Cancer Risk	
	Dermal	Inhalation				Short-Term	Intermediate-Term	Private Farm (7 days)	Commercial (20 days)	Private Farm (7 days)	Commercial (20 days)
Dust	0.018	0.0029	0.05	0.013	0.0021	60,000	22,000	2.1E-06	5.9E-06	6.8E-08	2.0E-07
Liquid			0.0625	0.016	0.0026	48,000	18,000	2.5E-06	7.3E-06	8.4E-08	2.4E-07

[Calculations performed on a spreadsheet before rounding to two places; therefore there may appear to be errors due to rounding]
Assumption: cotton seed treated using either dust or liquid at label rates shown in table.
Cotton seed planted over 80 acres = 1440 lbs seed handled per day.
Dose (mg ai/day) = PHED unit exposure for loading & applying granular formulation (mg/lb ai handled) x Application rate/lb seed x seed handled (lb/day)
Body weight = short-term 60 kg; intermediate-to-long term or cancer risk = 70 kg
MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)
LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr * 35 years working}}{\text{70 years (lifetime) x 365 days/yr}}$
Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]

Table 9: Terrazole Turf Residues: Post Application Day 0 (12 hr Post-Application): MOEs and Cancer Risk							
Non-Occupational Exposures							
Person/Activity	Study Residue (μg/cm2)	Transfer Factor = cm2/hr	Dose mg/kg/day	ST MOE	Activity (Days/ Year)	LADD mg/kg/day	Cancer Risk Estimate
Golfing Adult (60 kg)	0.13	100	8.7E-04	1.7E+04	18	2.6E-05	8.7E-07

Turf transferable residues study: EPA MRID 432878-02.

[Calculations performed on a spreadsheet before rounding to two places; therefore there may appear to be errors due to rounding]

ST = Short Term exposure, generally less than one week

Dermal dose (mg ai/kg/day) = (TTR(t) [$\mu g/cm^2$] x Tc (cm^2/hr) x DA x 0.001 mg/μg conversion x # hours (4) played/day) / body weight (kg)

Body weight = short-term 60 kg; intermediate-to-long term or cancer risk = 70 kg

MOE = NOAEL (mg/kg/day) / Potential Daily Dose (mg/kg/day)

LADD = Lifetime Avg Daily Dose = $\frac{\text{Absorbed daily dose (based on 70 kg body wt) x Exposure Days/Yr * 50 years playing}}{\text{70 years (lifetime) x 365 days/yr}}$

Cancer risk = LADD x Q_1* [0.0333 $(mg/kg/day)^{-1}$]